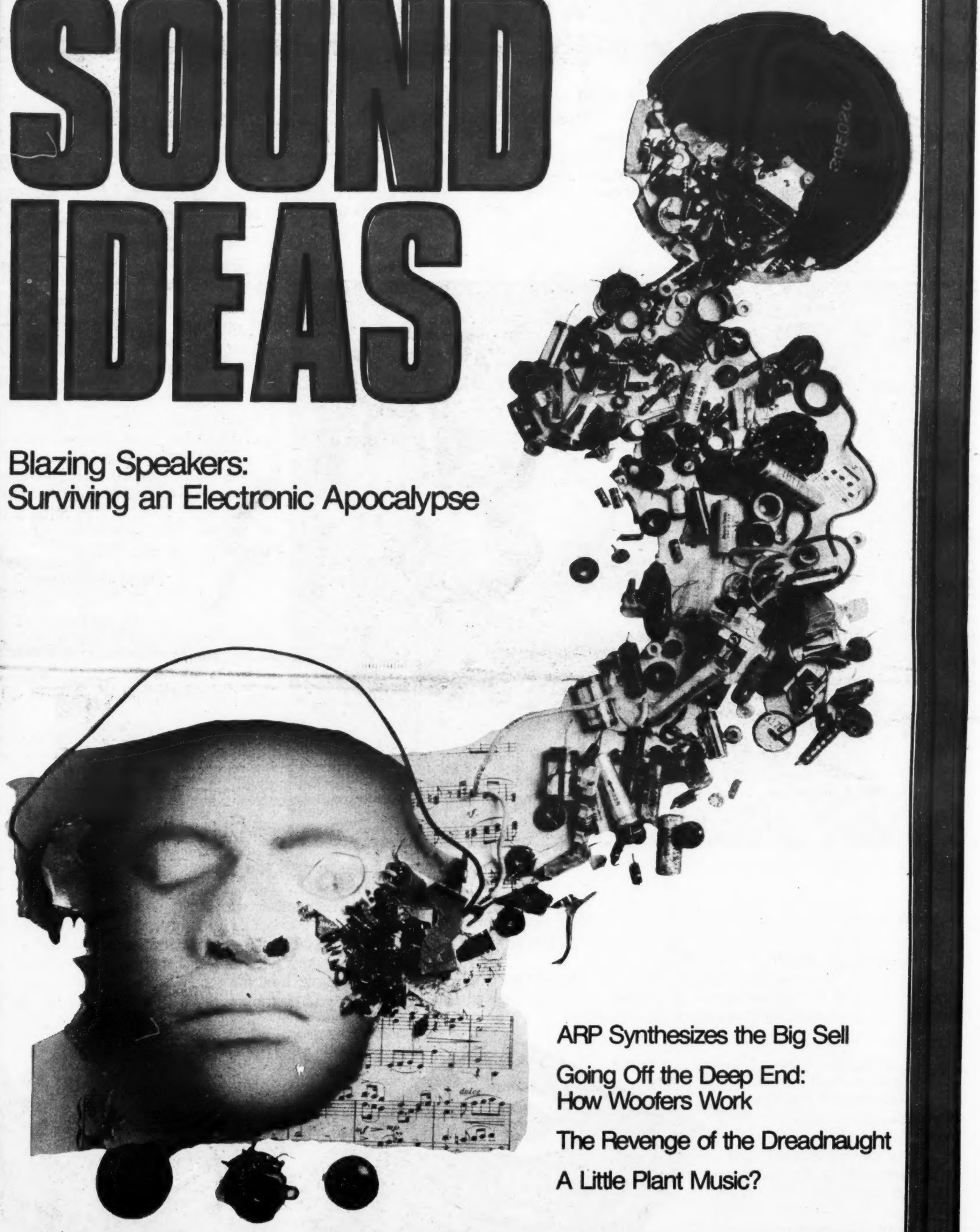
SOUND IDEAS



Blazing Speakers:
Surviving an Electronic Apocalypse

ARP Synthesizes the Big Sell

Going Off the Deep End:
How Woofers Work

The Revenge of the Dreadnaught

A Little Plant Music?

Construction by Hildy Maze

Section A / Magazine Supplement to

The Boston Phoenix

WE HAVE CHOSEN THIS RATHER UNORTHODOX WAY TO PRESENT THE NEW B·I·C™ TURNTABLES–BECAUSE THE NEW B·I·C TURNTABLES ARE RATHER UNORTHODOX.

Traditionally, new audio equipment (new anything for that matter) is introduced with orthodox "product shots".

In the case of the B·I·C 980 and 960 we're breaking that mold. We're taking you inside and underneath—because much of the real beauty of these instruments lies in the innovation and engineering that's there.

In the exploded view you see a combination of things not found in any other turntable—a belt drive system and a record support post. Never before has there been a belt drive turntable

with automatic multiple play capabilities. Only B·I·C has this combination.

At right you see the B·I·C program panel. With it you can operate these turntables manually. Or you can elect to play a single disc automatically. Or you can repeat a single disc as many as 6 times. Or you can play from 2 to 6 discs in series.

For the first time one turntable combines the advantages of a manual unit with the convenience of perfect automatic record handling—without sacrificing playback performance.

The Worm's Eye View

The underside of the turntable is revealing.

Compare it with the underside of any unit you choose and you'll be struck by the simple, clean appearance of the B·I·C

Many moving parts found in turntables with automatic features have been eliminated. (We've sold and serviced millions of automatic record players over the past 37 years and one thing we've learned is that simpler is better and less is more.)

The motor is a 24-pole, 300 RPM unit. It has the torque to move the platter to playing speed in ⅓ a revolution. The 1800 RPM units used in automatic turntables are simply no match for its smoothness, silence, and durability.

Only B·I·C has a 300 RPM 24-pole motor.

The 4 shock mounts at the edge of the unit plate form an acoustically damped interface between the unit plate and base. These hollow rubber, spherical cushions were designed specifically for B·I·C Programmed Turntables.

Conventional units use metal springs.

Other Intriguing Features

The B·I·C tone arm includes features you won't find on any other arm at any price.

The cartridge shell can be adjusted so that optimum 15° tracking can be achieved no matter how deep or shallow your cartridge body is.

Cueing time can be adjusted for from 1 to 3 seconds via a knob on top of the unit.

Seven other adjustments can be made from the *top* of the instrument which permit easy fine-tuning of the tone arm system, to a greater degree than has ever been possible before. The control tabs and linear scale for anti-skate and tracking force adjustment are unique. The cycle button which controls play is unique. Etc. Etc.

Dependability

B·I·C Programmed Turntables are made in the United States, in our own factories. We mention this because quality control is probably *the* most important factor in building this kind of equipment. The fact that the specifications for these turntables have been created and quality controlled by B·I·C is more important than you think.

Performance

We barely have space here to hint at the things you should know about these turntables and their performance.

Your audio dealer has a comprehensive 26-page booklet about them which includes performance figures, dimensions and details about the B·I·C 2-year warranty.

Get this booklet, or write for more information to Andrew Stephens, Dept. 3Q British Industries Co., Westbury, N.Y. 11590.

We think you ought to compare turntable features before you buy. If you compare ours with any and all others you're considering (price no object) we'll be happy.

We think you will be too.

B·I·C™

The 980 and 960 are identical except for the 980's electronic speed and pitch control circuitry and its lighted strobe. Accessories available include solid oiled-walnut wood base–matte black molded base–and hinged dust cover. The 980 sells for approximately $200. The 960 for about $150.

B·I·C is a trademark of British Industries Co., Westbury, N.Y. 11590. Division of Avnet, Inc.

Sound Ideas

Predicting Trends/ Larry Collins 4
Ron Dunlap and The Revenge of the Dreadnaught 1000/ Clif Garboden 8
Woofing It/ Roy Allison 12
Ode to a Boston Fern/ Jeffrey Linder 14
Other Eras, Other Ears/ Robert Long 17
They've Got the Whole World in Their ARP/ Peter Birge 23
A Short Primer on Electronic Synthesis/ Jim Michmerhuizen 24
I Hear No One When There's Music There/ Clif Garboden 32
So What Else Is New? 34

Sound Advice

How Much Power?/ Peter Mitchell 1
Blazing Speakers:
Living (?) With a Super Amp/ Jim Brinton 3
High Technology:
Cheap Frills or Ritzy Thrills/ Stan Perlmutter 4
Cutting Records: Waxing Philosophic/ David Griesinger 7
In the Beginning: All About Spees . . ./ W. Arkin Kanner 8
And How They Can Mislead/ Peter Mitchell 9
A Case of Tape/ Herkimer Bell 12
Getting Used to Used/ Bill Politt 14
STP: The Audiophile's Edge/ Robert Graham 16
Home on the Dynamic Range/ Larry Blakely 29

The Sounding Board

We get letters.

God, do we get letters.

Take last October's hi-fi supplement, for example. People wrote in to ask us: "Who *are* these persons and why are they saying all those terrible [or flattering] things about [me or my amp or my company or my $3500 loudspeaker]?"

Well, we feel we owe you an explanation. How's this?

Peter Mitchell is a scientist who is engaged as a technical writer for Advent and as a producer of WBUR's "Shop Talk." He has written numerous hi-fi articles for publications like *Stereo Review*, as well as the *Phoenix*, and is a past president of the Boston Audio Society, perhaps the most respected group of audiophiles in the country. Jim Brinton, the BAS's current president, is a former hi-fi editor at McGraw-Hill who is now freelancing, as is **Stan Perlmutter**, who turned to writing after working for several area electronics companies.

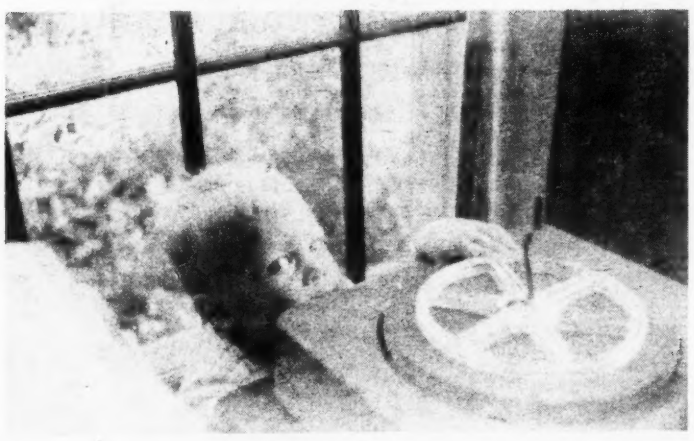
Larry Collins, who kicks off this supplement with a piece on trends in the industry this year, is an engineer who spends most of his spare time doing on-location recording for a local FM station along with designing and building audio gear. Speaking of audio design, **Roy Allison**'s Allison Acoustics have come out with two new speakers that have blown many a mind but nary a woofer, which, incidentally, is the subject of Roy's article this issue. Allison is a former audio magazine editor and VP of Acoustic Research.

For his article, **Robert Long**, the audio-video editor of *High Fidelity*, meditates on what it was like in the days of 78s, when recording musicians had to live with four-minute sides. Local recording engineer **David Griesinger**, who has contributed a piece on how a record is cut, says he wouldn't mind having as short a side in *appearance* on today's 33 1/3 LPs — because then they would sound so much better.

Better sound is one of the reasons **Robert Graham** decided to design an STP trough to provide tonearm damping. Not an OPEC rep, Graham works in satellite communications at MIT's Lincoln Laboratories. A better *appreciation* of sound is the subject of **Larry Blakely**'s piece on dynamic range. Blakely, a former Hollywood studio recording engineer, is a woodwind player of more than average gifts, a big-band buff and marketing manager for a suburban electronics firm.

All kinds of sounds are coming out of synthesizers these days, and the men who run ARP appear to be making the biggest noise. To get the signals straight, we asked **Jim Michmerhuizen**, director of the Boston School of Electronic Music, to give us a box explaining what all the fuss is about. And to explain what *all* the technical terms are about, we asked **Bill Kanner**, a former technical editor of *FM Guide* and a frequent contributor to *Crawdaddy* and a host of other publications, for a report on the basics.

So put on your Dust Bug and let's groove.



Sound so clear you can hear a pin drop, or a piccolo player catch his breath.

Listening to the Pep 79E is like being suspended from the concert hall ceiling with the microphones. Nothing comes between you and the music. Because we built a perfect membrane driver. An electrostatic element that produces the most transparent, distortion-free sound you've ever heard. And now electrostatic stereophones aren't bulky or isolating. The Pep 79E weighs a mere 8½ ounces, and our trans-air concept blends outside sounds with inside sounds without sacrificing performance. Frequency response: 10 Hz to 22,000 Hz. It's black, with Chroma trim, has comfortable ear cushions, a fully adjustable headband, and 15 foot coil cord. Comes with a trouble-free, self-energized console. The system is guaranteed for 1 year. The only alternative is huge, costly speakers that will wake up your neighbors.

Pep 79E Electrostatic System
Sugg. Retail Price $90.00

Superex Stereophones. Feel what you hear.

For free literature write: Superex Electronics Corp., Dept.20, 151 Ludlow Street, Yonkers, N.Y. 10705
In Canada, Paco Electronics Ltd., Quebec

SOUNDSCOPE INC.
779 Boylston St., Boston
291 Harvard St., Brookline
Mountain Farms Mall, Hadley
975 Elm St., Manchester, N.H.

SOUNDTRACK AUDIO
566 Cass Ave.
Woonsocket, R.I.

WALTHAM CAMERA
365 Moody St., Waltham

YOU-DO-IT ELECTRONICS
40 Franklin St., Needham

Predicting Trends: Why You Need An Expert to Tell You What's Happening. . . And Why You Can't Believe What An Expert Tells You

By Larry Collins

Since "high fidelity" is the technology of reproducing music in the home, improvements in the realism of the sound usually involve either new technology or fresh applications of an existing technology. This has become so commonplace that when a manufacturer brings out a new product he usually invents a technico-freaky name to go along with it. Then, instead of selling you the product, all he has to do is sell you the idea of the technological "innovation" behind the product's supposed superiority. As every politician and quack cultist knows, people who can resist a sales pitch for a product will lap up a sales pitch for an impressive idea, and once they've bought the idea, the product will sell itself (be it a "natural" food, the B-1 bomber or a loudspeaker that looks like the Jolly Green Giant's reproductive organ).

Consider a few technological "advances" in audio: MOSFET, Dolby, ffrr, acoustic suspension, chromium dioxide, Stabilized Radiation Loading, Air Motion Transformer, Dynamic Coupling Factor, OCL/OTL, dynamically balanced arm, SEPP, ADRS, Cobalt-doping, Tuned-Port . . . . Some of these represent genuine advances which you should know about before you buy a system; others are just efforts to promote undistinguished products. But which ones?

Every year technology freaks like me are asked to sort out the hype and try to forecast how technology actually will shape the audio scene in the coming months. We cheerfully make predictions — by analyzing current trends and by using inside knowledge of new concepts and products being developed.

Such "expert" predictions are nearly always biased, and always in the same way — toward excessive optimism. If we are "experts," it is because we are first enthusiasts; we delight in discovering better sound. And when we find a new process or product that is genuinely better, we hasten to tell the world about it. Our predictions and prophecies are colored by wishful thinking, because once we have seen (heard) the marvelous potential of a new method or device, we are impatient for everyone to share in its benefits. We predict its imminent availability. Then, when practical engineering or marketing difficulties delay its appearance or cause it to appear in a cheapened form which fails to live up to the high expectations our enthusiastic predictions have created, everyone becomes overly disappointed and pronounces the whole idea a bomb.

Prime Example: Four-Channel

Have you ever heard a four-channel system that was vastly better than the best two-channel stereo — so good that if it cost twice as much as a good stereo system, it would still be a bargain?

Probably not. It has been seven years since the first industry demonstrations of quadriphonic recording (the demos which started all the "experts" raving that four-channel is the wave of the future). But in all that time, relatively few consumers have heard quad demonstrated convincingly. Properly done, four-channel is fantastic, a much bigger improvement over two-channel stereo than stereo is over mono. But hi-fi dealers are not providing good demos, and partly for this reason; quad accounts for only about 10 percent of equipment sales (locally, even less). Everywhere, dealers and experts are claiming that four-channel has bombed — or even that it is dead. Reacting to this gloom, a conference of manufacturers meeting in Chicago recently attempted to organize a unified industry-wide PR campaign to regenerate enthusiasm for quad.

What we have here is a case of excessive disappointment. It may be worth remembering that it also took seven years (1955-1962) for two-channel stereo to become popular. Stereo tapes were available in 1955 and compatible stereo discs in 1958, but most audiophiles stayed with their mono systems until stereo FM broadcasting started in 1961. In the case of four-channel, tapes became available in 1968 and disc records in 1971-72, and the FCC will not authorize a special quad broadcasting system until late this year or sometime in 1976, so it was unreasonable to expect four-channel to be already dominant by 1975.

The War Goes On

Of course, the growth of four-channel has been slowed by the Great Quad War. I am amused whenever someone suggests that quad was created as a gimmick to boost equipment sales. In fact, the big proponents of quad are too busy fighting each other to be able to conspire about anything. They already have three methods of making four-channel records, each requiring its own non-compatible decoder for playback. Two more encoding systems are waiting in the wings.

Since records are an international commodity, the quad wrangle will be settled internationally, if at all. In the U.S., of course, the battle is disguised as the third of the modern wars between RCA and Columbia. In their first encounter Columbia won the Great Microgroove War with its 12-inch, 33-1/3-rpm record. RCA wasn't completely defeated, since its seven-inch, 45-rpm donut disc survived as the format for the pop single. RCA then wiped up Columbia in the Great Color TV Race; RCA's multiplex system was adopted by the FCC as the official mode of color-TV broadcasting in this country, and the only use anyone has found for the Columbia sequential-color system is in the Apollo spacecraft.

So, when Columbia plunged into the four-channel foray with the SQ matrix system and supported the SQ format with its enormous marketing muscle as the country's largest record manufacturer, observers looked forward to a good fight. RCA returned that opening salvo by adopting the Japan Victor CD-4 discrete system and issuing a few records. The fight was on.

To many observers, the combatants seemed about equally matched, and the potential existed for a long war. To Columbia's advantage, it had gotten into the market first and with many more records than RCA. Furthermore, SQ discs were compatible with ordinary equipment, could be broadcast on FM and required no special advances in phonographic technology either to make or play them. To RCA's advantage, the CD-4 system really did provide four discrete channels, while early SQ decoders had such poor channel separation that what they produced was more like Giant Mono than real four-channel.

This poor separation was a crucial failing for SQ, and it deterred the prestigious European

Continued on page 6

THE LAST LOUDSPEAKER (REVIEWED).

When we introduced the Ohm F a few months ago, we called it the last loudspeaker.

We explained that this new invention (U. S. Patent 3,424,873) is the last loudspeaker in the same sense as the wheel was the last device for transmitting rotary or rolling motion.

Like the wheel, we said, our speaker is a mathematically perfect engineering concept, utterly simple and unimprovable. Only its physical construction can evolve further, not the design itself. When a single cone reproduces 30 to 20,000 Hz without crossovers and has a cylindrical output in perfect phase with the input signal at all frequencies ("coherent sound"), the design can be considered final.

Since then, our claims for the Ohm F have found support in the authoritative editorial pages of Stereo Review. In the November 1973 issue, the Equipment Test Reports by Hirsch-Houck Laboratories asserted:

"The Ohm F can do some things that no other speaker in our experience is capable of."

After acknowledging that "the cone has not been designed to function as a 'piston' (as virtually all other cones are), but should be viewed as a terminated acoustic transmission line," the review states that "the Ohm F produced one of the flattest extended curves we have ever seen ...it has a uniform energy output across the full audio-frequency range..."

Square-wave tests of the Ohm F against "several other fine speakers we had on hand," in the words of the review, showed that "only the Ohm F was able to produce a reasonable facsimile of a square wave." This plus the toneburst response of the speaker "tended to confirm . . . that it has transient-response capabilities surpassing those of the best conventional (piston) speakers."

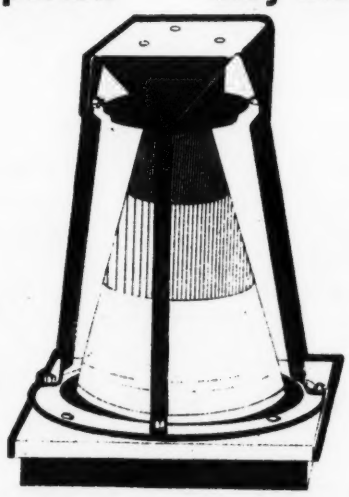
Further excerpts from the Ohm F test report:

"In our simulated live-vs.-recorded test it rated A to A+ . . . with one of the larger power amplifiers, able to deliver 100 watts or more, the sound began to warrant the use of such words as 'awesome' . . . achieves state-of-the-art performance."

The conclusion of the review requires some reading between the lines:

"As to whether or not the Ohm F is therefore the 'best' speaker available—we will leave that to the ears of audiophiles; we are prepared to say, however, without reservations, that it is easily one of the best."

Think about that. Wouldn't any responsible journal hesitate to declare categorically that a totally new and unfamiliar product is the best, period? Even if they thought so?



The Ohm F comes in a striking, tapered column cabinet, about 3½ feet high, and is priced at $500. If your local dealer doesn't carry it yet, write us and we'll help you.

We want your next loudspeaker to be the last loudspeaker.

Ohm Acoustics Corp.,
241 Taaffe Place,
Brooklyn, N.Y. 11205.

Ohm

Trends

Continued from page 4

companies (DG, Philips, Decca/London) from adopting SQ. EMI, England's largest record maker, did adopt SQ but has issued only a limited number of SQ discs, and EMI's American affiliate, Angel, declined to accept SQ. Of course, the technical difficulties in CD-4 were formidable, but RCA's multiplex color TV system was also much more complex and difficult than Columbia's, and color TV is a success nonetheless. If RCA had simiarly overcome the technical obstacles in CD-4, the European companies might have signed up and jointly established CD-4 as the audiophile's standard for quad.

RCA Loses by a TKO

It may be too early to declare the Great Quad War over, but the battle between the two American contenders has become very one-sjded. RCA has not conceded defeat, but I am convinced that SQ has won. I cite these points in evidence.

(1) Two years ago DG set up a quad evaluation lab at their headquarters in Hanover, Germany. They were initially predisposed to CD-4 because of its clear technical superiority and were disposed against matrix methods like SQ because of their amorphous playback. (Indeed, the Japanese affiliates of DG and Philips, Nippon Polydor and Nippon Phonogram, did adopt CD-4 and released many discs.) But after two years of study, DG remains unconvinced that CD-4 can be made practical for large-scale use by the worldwide record-playing public. DG, Philips and Decca/London reportedly have agreed to act jointly in adopting a quad format, and it is significant that after two years of work on CD-4, they still have reservations about its practicality (even with their superior pressing quality).

(2) Columbia has established an initial advantage by getting its quad records out on the market first and in larger numbers than RCA. In order to win the war, RCA would have to issue quad records rapidly and catch up to or surpass Columbia, because people won't buy decoders unless they can find lots of material to play. (This is especially important for a quad system, which cannot also be used to enhance the playback of two-channel stereo discs.) However, the number of CD-4 releases has been falling farther behind, rather than catching up. A recent Schwann catalog survey indicated that in the SQ format there are four times as many classical and twice as many pop and jazz discs as in the CD-4 format.

(3) The crucial problem for CD-4 lies in the economics of pressing. There has been an enormous expansion in record sales during the past 15 years, and in order to keep up with the demand, the record makers have had to build new pressing plants and force each stamper to turn out records faster. Records are made by pressing molten vinyl between two grooved stamper plates, waiting while the vinyl cools and solidifies, and then separating the plates to remove the finished disc. To speed up production, the cycling time of the stamper press is shortened by a few seconds, and the record is either force-cooled or is picked off the press before it has fully hardened. The result is warped discs and noisy grooves. (This is why American pressings are poor compared to European and Japanese discs.) Furthermore, as time goes by it will become increasingly difficult and costly to make high-quality vinyl records, because vinyl is a by-product of oil. Now, the ultrasonic subcarrier which supplies the rear channels in CD-4 involves extremely tiny groove modulations, and when the pressing quality is degraded, these are the first to go. To minimize the severe rear-channel distortion that results in playback, the newest CD-4 demodulators appearing this year contain a phase-locked loop to "remember" the subcarrier signal during those periods when it disappears owing to pressing defects or record wear. But it is a losing battle.

(4) Cutting disc masters for CD-4 has also proved to be very time-consuming. There are dozens of mastering labs in the country which can cut good stereo and matrixed quad discs, but two years after the introduction of CD-4, there still is only one mastering lab able to cut good CD-4 masters: the JVC Cutting Center in Hollywood. And difficulties remain even there. The ultrasonic subcarrier cannot be cut at its true frequency; therefore, all of the early CD-4 discs were cut at 12.5 rpm instead of 33 rpm. After two years of development, they have managed to speed up the cutting to 16.7 rpm. And since cutters (and playback cartridges) are velocity-sensitive, every master tape must be elaborately frequency equalized to compensate for the slow cutting. The master disc-cutting process is arduous and time-consuming, and in the record business time is money.

(5) JVC has announced that beginning this spring, they will be importing Japanese CD-4 discs and selling them by mail order. By implication, this is an admission that the problems of cutting, pressing and distributing CD-4 discs in this country are too serious for solution in the near future.

What About SQ?

Calling CD-4 a loser doesn't automatically make SQ a winner. In fact, Columbia is at least as responsible as RCA for the negative image most people have of four-channel sound. After all, most people have never heard *any* demonstration of CD-4, good or bad. In general, when people have heard an unimpressive four-channel demo, it has been with matrixed quad (either SQ or QS), with the vague channel separation that characterizes matrix systems. If Columbia had waited until they had perfected the decoders before rushing onto the market with SQ, there might have been a lot less disappointment with quad.

"Perfected" is perhaps too strong a word. There are inherent limitations to how accurately four distinct channels of sound can be decoded from a matrixed recording. But the ear is not an oscilloscope; it is an adaptive biological organism which, like the eye, can be fooled by an artful illusion. And the newest SQ and QS decoders make clever use of psychoacoustic legerdemain (the hand *is* quicker than the ear!) by varying the amplitudes and phases of the four decoded channels in accordance with cues in the matrixed signal, thus fooling the ear into hearing full separation among the channels. Try it, you'll see. Thanks to the use of integrated circuits, these advanced decoders will be appearing in greater numbers this year. (Yes, I know that we have been hearing about "better" decoders every year since SQ was introduced, but this time they really *are* good.) The magic words to watch for are "wave-matching logic with variable blend" for SQ and "variomatrix" for QS.

I include QS together with SQ in this discussion because they are similar, varying only in the phase and amplitude characteristics of the encoding matrix. In terms of available records, SQ is more important, especially in the classical repertoire. Of course, the best reason for buying a matrix decoder, either QS or SQ, is for the dramatic enhancement it provides of the broad range of two-channel records and broadcasts already available. Many existing recordings, played through a decoder into rear or side speakers, sound nearly as good as official "four-channel" records. Hence, the availability of interesting encoded quad records should not be the basic criterion in deciding whether to buy quad equipment; for several years to come, any quad matrix system you buy will be used mostly to play two-channel stereo material in enhanced sound.

What About Those Other Systems?

If the recording industry were characterized by intelligence and consideration for the consumer rather than by greed, the SQ/CD-4 war wouldn't have happened. The sensible approach would have been to investigate all possible quad systems, find the best one and get the entire industry to agree on it. Something like that was in fact done for the introduction of the stereo disc in 1958. Naturally, now that SQ, QS and CD-4 have confused things, the research is finally being done, and systems which may be substantially superior to those three are being developed.

One, a combined matrix/discrete system named QMX, was developed by Prof. Duane Cooper at the University of Illi-

Continued on page 38

A Great Package—4030/XP-60-S/215X/PC-5

Private Listening
Separate headphone jacks for the front and rear channels are provided on the front panels.
Clutched Front, Rear Volume/Balance Controls
Unique, clutched front and rear volume/balance controls allow adjustment of the front and rear channel volumes separately depending on the program material. To balance the volume between the left and right front speakers or the left and right rear speakers, the appropriate volume control can be adjusted so each portion operates independently.
Selector Switch
Enjoy phono, FM, AM, or any number of auxiliary program sources. The Aux/CD-4 position provides a quick and easy way to select the output of an external CD-4 demodulator.
Walnut Vinyl Cabinet
A handsome walnut vinyl cabinet is included at no additional cost.

Technical Specifications FM Tuner Section

Usable Sensitivity (IHF Standard)	2.0 uV
Harmonic Dist. (at 400 Hz 100% Modulation)	
Mono	0.5%
Stereo	0.8%
Signal-to-Noise Ratio (at 100% Modulation & 1 mV input)	65 db
Selectivity, Alternate Channel	55 db
Spurious Response Rejection (at 88 MHz)	85 db
Image Frequency Rejection (at 88 MHz)	60 db
IF Frequency Rejection (at 88 MHz)	80 db
FM Stereo Separation (at 1 KHz)	35 db
Capture Ratio, IHF, at 1 mV	1.5 db

AM Tuner Section

Usable Sensitivity (IHF Standard) S/N 20 db Loop Antenna	250 uV/m
Selectivity (at 1 MHz & ± 10 KHz)	40 db
Image Frequency Rejection (at 1 MHz)	45 db
IF Frequency Rejection (at 1 MHz)	40 db

Amplifier Section

Total IHF Music Power	80W
Total RMS Power (at 1 KHz) 4-channels driven, (at 8 ohms)	48W (12/12/12/12W)
RMS Power (at 1 KHz) 1 channel driven (at 8 ohms)	14W
Stepped Total RMS Power (at 1 KHz) both channels driven (at 8 ohms)	44W (22/22W)
Harmonic Distortion (at 1 KHz) & Rated RMS power	1%
Harmonic Distortion (at 1 KHz) & Rated RMS power –3 db	0.3%
IM Distortion (60/7,000 Hz 4:1 SMPTE at rated RMS power –3db)	1%
Power Bandwidth, IHF (at 8 ohms)	25-25,000 Hz
Sensitivity (for rated output at 8 ohms at 1 KHz)	
Phono	2 mV
Auxiliary	150 mV
Tape Monitor	300 mV
Recorder Output (30% Mod.)	150 mV
Hum & Noise (below rated output) Phono	56 db
Auxiliary	65 db
Tape Monitor	65 db
Frequency Response Phono (RIAA equalized ±2 db)	30 Hz-15 KHz
Auxiliary input ± 2 db	20 Hz-20 KHz
Tape Monitor input ± 2 db	20 Hz-20 KHz
Maximum Input Signal (at 1% THD)	
Phono	40mV
Auxiliary	2V
Tape Monitor	2V
Input Impedance	
Phono	47 K ohms
Auxiliary	80 K ohms
Tape Monitor	100 K ohms
Damping Factor (1 KHz at 8 ohms)	20
Volume Control Tracking (0 to –50 db)	3 db
Bass Control Range (at 50Hz)	± 12 db
Treble Control Range (at 10KHz)	± 11 db
Loudness Contour (at 30db volume attenuation)	8.5 db at 100 Hz 5db at 10 KHz

General

Dimensions (including control panel, cabinet, AM antenna)	19⅝" w x 7" h x 12⅛" d
Weight	19 lbs.
Power Consumption, Max.	175 W/190VA

All Fisher receivers are rated for continuous power, with all channels driven at rated load impedances. For comparison with other products, the IHF music power rating is provided.

The Fisher XP-60-S—Three-Way Bookshelf Speaker System
This system features a beautifully sculptured grille. Each system has an 8" woofer capable of reproducing frequencies down to 33 Hz; a 4½" mid-range, and a 2" tweeter. The frequency range of each system is 33-20,000 Hz.

Technical Specifications

Frequency Response	33-20,000 Hz
Max. Music Power	20 Watts
Bass Speaker Diameter	8"
Voice Coil Diameter	¾"
Free Air Resonance	40 Hz
Magnet Structure	1½ lbs.
Mid-range/Treble Speaker Diameter	4½"
Voice Coil Diameter	½"
Magnet Structure	½ lb.
Treble Speaker Diameter	2"
Voice Coil Diameter	¾"
Crossover Frequencies	850, 4000 Hz
Impedance	8 ohms
Dimensions	23⅛" x 12" x 10" deep
Weight	21 lbs.
Cabinet	Walnut Finish Vinyl

The Fisher 215X/PC-5 Automatic Turntable
Whisper-quiet, with a wide variety of quality features, the Fisher 215X is a valuable addition to every music lover's audio component system. To begin with, the 215X is equipped with an ultra-compliant magnetic cartridge to track your records with minimal stylus pressure... and a diamond stylus so that it and your records last longer. Played manually, the tonearm can be raised or lowered at any selected point on the record, using the cue and pause control. There is a skating-force compensator which applies pressure to counteract the natural side-thrust action of the tone arm, thereby permitting the stylus to retrace the record grooves more accurately, insuring optimum stereo separation and distortion-free performance. Wow, less than 0.2% RMS. Flutter, less than 0.06% RMS. Other features include a stylus pressure gauge, record size selector, and interchangeable center spindle for manual or automatic play. The Fisher 215X is available with a PC/5 protective dust cover.

Fisher

Fisher Radio, 11-40 45th Rd., L.I.C., N.Y. 11101

© 1974 FISHER RADIO PRINTED IN USA SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE ILLUSTRATIONS OF FINISHES MAY VARY SLIGHTLY FROM ACTUAL FINISH

MITCHEL'S TV & STEREO
76-80 Merrimack St.
Haverhill, Mass.

MUSIC STABLE III, Inc.
Village Plaza
Marblehead, Mass.

SOUTH SHORE STEREO
8 Plaza East
Marshfield, Mass.

(Some Clear Information from Advent on Loudspeakers)

Bass.

Sound is air in motion — pushed, pulled, beaten, blown, plucked, talked, or sung into motion.

Bass, particularly the bottom octave of music, is a *lot* of air in motion.

Because moving that much air is obviously heavy work, many speaker manufacturers have made it also sound like difficult and expensive work, the kind you really have to pay for to get done properly.

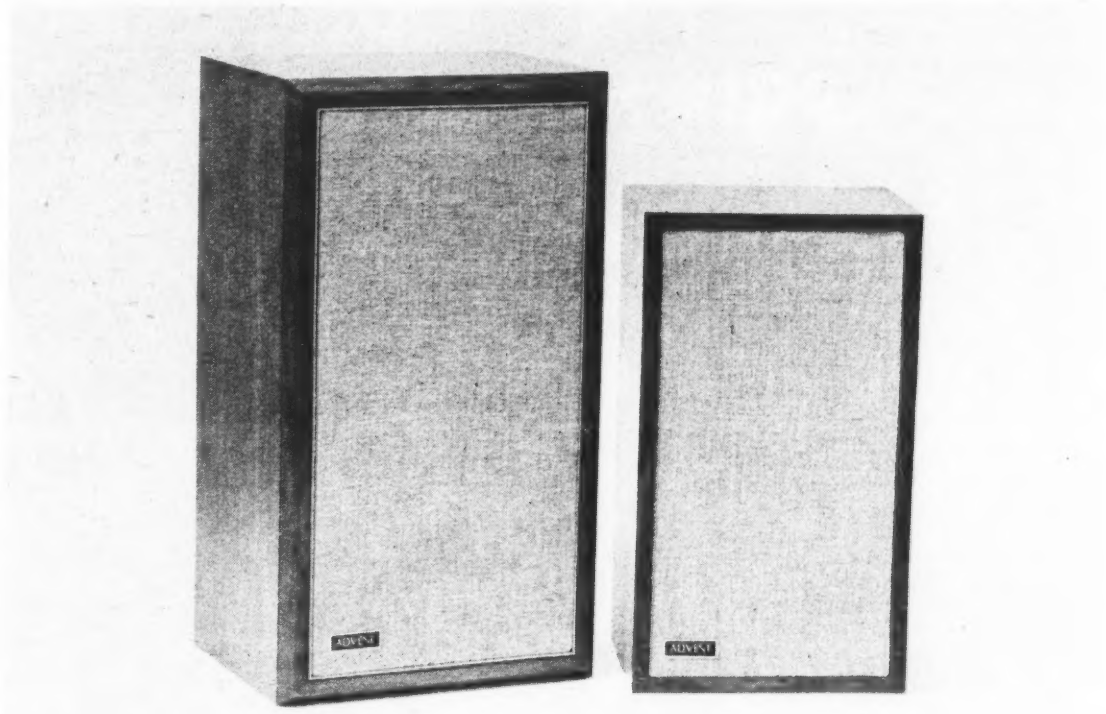
But it isn't. There is no reason why a speaker has to cost many hundreds of dollars to reproduce the final, lowest octaves of bass, and no reason why it has to be in a massive cabinet to do the job properly. In fact, most speakers that are big and expensive are that way simply because their design is unduly influenced by what was done twenty years ago.

The earliest speakers for hi-fi systems were fast adaptations of systems designed for theaters. Those speakers had to be big. Not so much because they had to produce a lot of sound, but because the suspensions of their speaker cones were stiff — so stiff that the cones couldn't move very far to push and pull air without getting into trouble. The suspensions were also inherently "non-linear," since the resistance to the motion of the speaker cone got worse as the desired motion got greater. So instead of a cone of reasonable size and cost in a cabinet of reasonable size and cost, the rule was either a cone with a bigger area or a big box — like a bass-reflex or horn enclosure — that could, over a limited range, augment the bass produced by the speaker itself.

The quality of the bass those big speakers produced (and still produce) wasn't all that wonderful. Even with big speaker cones and huge boxes, the stiff suspension tended to flatten out the motion of the cone in both directions of cone travel as higher volumes were needed, and the resulting sound tended to take two steps up the frequency scale. That is, if you fed a 30 Hz tone to the speaker and turned up the volume, what came out was more (and more) sound at *60 and 90 Hz* instead.

The first acoustic-suspension speakers changed everything by getting rid of the stiff mechanical suspension and replacing it with the calculated — and linear — stiffness of the air trapped inside a relatively small enclosure. The "air spring" or "air suspension" helped produce more and better bass than the monster cabinets had produced. And despite the arguments that the big-speaker lovers used to "prove" that the smaller acoustic-suspension units couldn't do what the ears said they were obviously doing, the acoustic-suspension units quickly and derservedly took over the lion's share of the speaker business.

Some of us at Advent have been involved with acoustic-suspension speakers from the beginning. It became obvious to us as manufacturing techniques got better that, with the design barrier out of the way, there could and should be less expensive ways of doing the job even better.



Accordingly, our first speaker, the Advent Loudspeaker, was designed to produce as extended and uniform bass as any speaker of any price (or size) for a cost of just over a hundred dollars ($107-$121 depending on the cabinet finish). Our next speaker, the Smaller Advent Loudspeaker, was designed to provide the *same* bass response in a system of half the size and two-thirds the price of the original, the only difference being that the original unit will play louder in bigger rooms. The Smaller Advent, which will play more than loud enough to make most people cringe in most living rooms, is probably the best bargain ($74) in any equipment category in the high-fidelity business.

The truth is that bass isn't hard to design into a loudspeaker.

The truth also is that the big theater-style speakers still seen and heard in rock halls and studios almost invariably don't produce as extended or as good bass as either of these two Advent speakers (or other more expensive but good acoustic-suspension units from other manufacturers).

YOU CAN SEE AND HEAR ADVENT SPEAKERS AT THE DEALERS LISTED BELOW:

ATLANTIS SOUND

BOSTON
536 Comm. Ave.
811 Boylston St.
BRAINTREE
Store 17
South Shore Plaza
CAMBRIDGE
38 Brattle St.
FRAMINGHAM
248 Worcester Rd.
PEABODY
10 Sylvan St.
PROVIDENCE, R.I.
261 Thayer St.

Music Box

WELLESLEY
58 Central St.

TRIPOD AUDIO

AMHERST
98 N. Pleasant St.
NORTHAMPTON
219 Main St.

Tweeter etc.

BOSTON
163 Amory St. (Boston U.)
BROCKTON
849 Belmont St. (Rte. 123)
CAMBRIDGE
102 Mt. Auburn (Harvard Sq.)

tech hifi

Quality Components at the Right Price

BOSTON
870 Comm. Ave
240A Newbury St.
CAMBRIDGE
30 Boylston St.
(The Garage, Harvard Sq.)
182 Mass. Ave. (MIT)
DEDHAM
Route 1
FRAMINGHAM
Route 9
NASHUA N. H.
Nashua Mall Extension
PROVIDENCE, R. I.
165 Angell St.
RANDOLPH
52 Teed Drive
STONEHAM
352 Main St.
WARWICK, R. I.
1989 Post Road
WORCESTER
279 Main St.
PORTSMOUTH, N. H.

Ron Dunlap (BS, MD, dB) and The Revenge of the Dreadnaught 1000

Doctor my amp

By Clif Garboden

This is a story about a man and his amplifier, in which we explore these questions: "Is there a black Horatio Alger living in Porter Square?" and "can two mild-mannered Americans soldering circuits in a Cambridge basement beat the mighty Japanese at their own semiconductor game?" After all, only in America can a kid without a cent get a break and maybe grow up to invent a 1000-watt amp.

Cliff Garboden

Dunlap (above) and the Monster (below)

Dunlap Gets Mad

Back in 1968, Ron Dunlap, a young Harvard med student with a BS in engineering from Brown, trucked into the old Audio Lab store in Harvard Square.

"I found myself with a little spare cash — very little, about $85 — but I was out to buy myself a sound system. I was just like any other first-time customer. I didn't know much of anything about hi-fi equipment and I had no idea about what things cost." Ron's appearance bespoke his buying power, but his champagne taste surfaced despite his innocence.

Ron remembers: "I looked at all the equipment, and then I came to this big Scott amp. So I said to the sales clerk, 'I like the way this one looks. How much does it cost?' Well, he looked at me like I didn't even have any business asking the question. It was like he said, 'Move along, son. You could never buy that.'" Which was true enough at the time, but that didn't make Ron feel any better. As a matter of fact it made him a little mad.

"I listened to that salesman," Ron goes on, "and then I went around to other stereo stores checking out the equipment. I wasn't too familiar with sound technology, but I had enough background in electronics to know that most of what the salesmen said didn't really make any sense."

Austerity Is the Mother of Invention

Ron wasn't getting any richer, but he still wanted an amp, so, poor and a little resentful, he set out to build his own. On the strength of his Brown degree and his experience working in medical electronics with the Public Health Service in Washington, he was hired part-time at Hewlett-Packard in Waltham. Thus financed, Ron's next step was to wangle an instruction manual for an amplifier kit — an uncommon tactic since he didn't offer to buy the kit. It was even more unorthodox for him to construct the innards out of what surplus components he could afford and then go back and purchase a case and front-panel plate.

An irrepressible engineer, Ron Dunlap couldn't bring himself merely to duplicate the kit amplifier he started to build. He modified it here and there, applying some things he knew and trying some things he didn't. When he was done, he had this homemade amp that looked like a Scott unit on the outside but was a cleaner power machine than he could have bought in the first place.

Ron became so immersed in his project that he couldn't keep it to himself. He took his modified Scott around to local dealers and had it tested and compared to various stock units. It was better. As a matter of fact it was so noticeably better that one night a customer sat in on his floor demonstration and bought the amplifier on the spot.

This was an unexpected boost, and Ron decided to build some more amps. But the lack of big bucks has dogged the Dunlap odyssey from the start. Ampless, once again, and only slightly more capitalized, he took on yet another job, selling for Tech Hi-Fi in Stoneham, where they let him collect most of his pay in equipment.

"I was working all the time, between school and Hewlett-Packard and Tech HiFi," Ron recalls, "but I was able to build more amplifiers. I started working with an engineer friend of mine named Mel Clarke. We put some things of our own together and took them down to a Marantz clinic. They checked out beautifully, so we decided to go into business.

They All Laughed When I Sat Down at the Drawing Board

Within what Ron Dunlap remembers as "a few days," the whiz kids had finished a prototype of a new monster amp, affectionately called "the Pig." The Pig worked. It was a tightly engineered, high-powered amp that did everything the chrome-plated models in the showrooms could do, including blow up, which it did whenever somebody pushed it too far. Since sputtering fires are not unknown in the upper db stratum of the high-fidelity world, Dunlap and Clarke developed their own heavy-duty protection circuit that shut the Pig off at the first signs of impending overload. They now had a product and a *bona fide* product improvement.

(An improvement, incidentally, that has since caused its share of confusion. Ron explains: "We knew we had to build a protection circuit that was smarter than the customer. We have never been able to defeat the idea that something this big is made to be abused. We sent a unit to one stereo store in Pittsburgh, and they kept writing back telling us that the amp broke every time they used it. The truth was that they had tried to blow it up three times, and it kept shutting itself off to save its own life.")

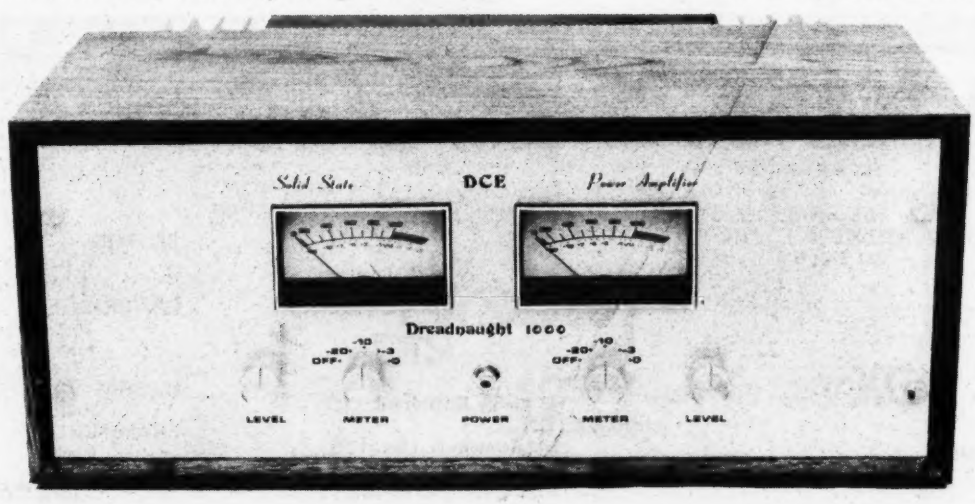
Clarke got together a small loan, and Dunlap started churning out piglet prototypes, selling them as fast as he could solder them together to finance the business.

It's no exaggeration to say that Dunlap Clarke Electronics organized its first production run from Ron's basement. Nevertheless, the amps got around. At that time Dunlap Clarke was producing two models, the Dreadnaught 500 and the Dreadnaught 800. The 500 series version was the 500-watt little brother of the 800, which was the primordial monster in drag — direct descendant of the Pig. Sound system pros and rock bands latched onto some of the bigger models, but it was mostly the heavy sound freaks who greeted the fruits of the Dunlap Clarke kitchen table assembly line as God's latest gift. The Dreadnaughts became an underground sensation, but two guys hand-drilling chassis on the weekends can't meet any sizeable market demand. The sheer unavailability of the product turned the Dunlap Clarke amps into classics, touted along the audiophile grapevine as *the* high-powered miracle. Dreadnaughts became legends, their reputation spread around elite circles all the way to California before the emerging company had produced 40 units.

Praise is cheap, but great fortune is slow in arriving. And besides, there's that great American bromide which says that "you have to spend money to make money." Dunlap and Clarke still didn't have much money to spend, so they went begging. Credit is also a straggler.

Dunlap recalls their audience

Continued on page 10

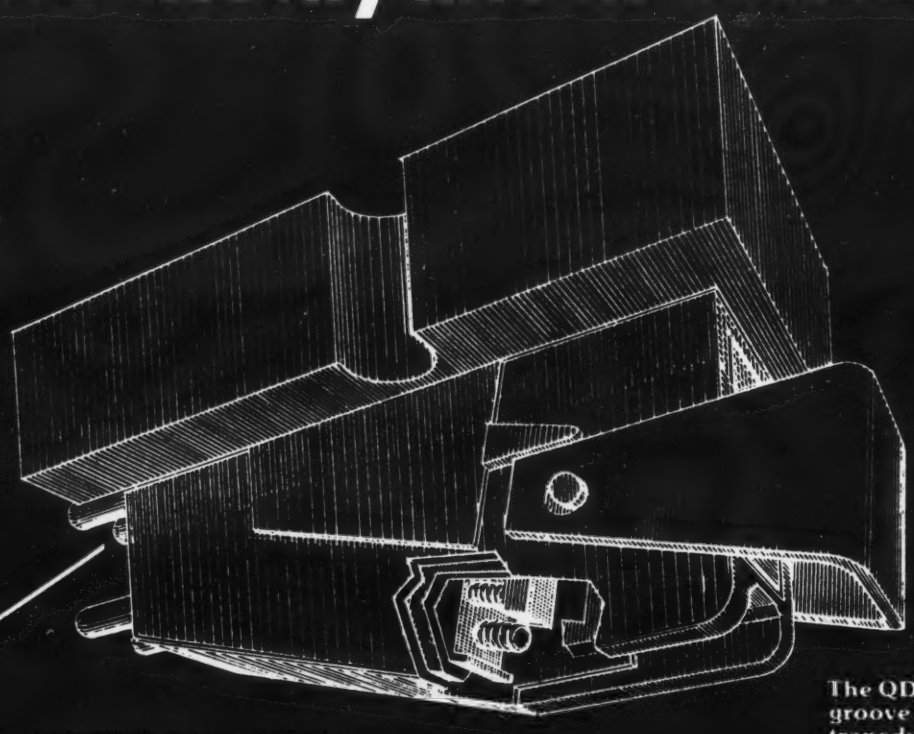


"Look at that, there's hardly anything inside here. Of course, that's what people always say when they look inside our amps. Yeah, there's nothing in here but some guy's brains."

ma

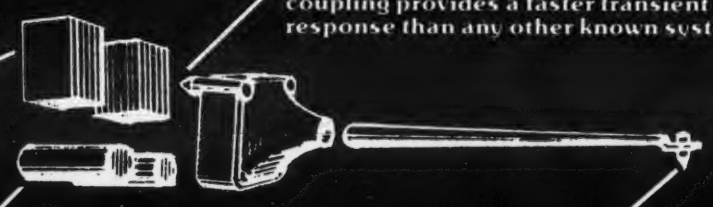
The new Micro-Acoustics QDC-1 Stereo Phono Cartridge:

It will make any well recorded LP sound exactly like its master tape.



The QDC-1 has a low resistive (non-inductive) output impedance so that high frequency response is unaffected by cable capacitance. In addition the pre-amp input impedance is shunted, reducing thermal noise by 3-6 dB as compared to inductive type cartridges.

The QDC-1 stylus bar transmits the record groove modulation directly to the transducers by means of two coupler pins. This unique method of lossless direct coupling provides a faster transient response than any other known system.



The QDC-1 electret transducer generates a perfectly linear signal from 5 Hz to 50 kHz, without the phase shift normally associated with inductive transducers. Its reproduction of complex wave forms is equal to the best direct coupled amplifiers.

The QDC-1 Series 300 playback styli (QDC-1e, 1s, 1q) are shaped and polished with the same ultra precision as our world famous Micro-Point recording styli.

The QDC-1 stylus is balanced by two elastic bearings positioned to provide precise 45 -45 signal resolution. These bearings are the exact mechanical analogue of a push-pull output circuit. The result is significantly lower phase and second harmonic distortion as compared to the conventional, loosely suspended, single bearing designs.

AVAILABLE AT:

tech hifi

Massachusetts 240A Newbury St, 870 Commonwealth Ave Boston 38 Boylston St, 182 Massachusetts Ave, Cambridge, Route 9 Framingham Route 1, Dedham 352 Main St, Stoneham 667 Main St, Waltham 279 Main St Worcester 48 Todd Dr, Randolph 186 Main St Northampton 253 Triangle St, Amherst **Connecticut** Caldor Shopping Center, West Main St Avon **New Hampshire** 2 Worth Plaza, Portsmouth Main St, Hanover Nashua Mall Extension, Nashua **Vermont** 150 Church St Burlington 21 Main St North Bennington **Maine** 342 Fore Street, Portland **Rhode Island** 165 Angell Street Providence 1989 Post Road, Route 1, Warwick

SUFFOLK AUDIO

High Performance is the Standard

1105 Mass Avenue Cambridge Mass 02138 868 1080

Dunlap

Continued from page 8

with the State Street Bank. The honcho they approached for a loan was immediately impressed with the sound equipment.

"He must have thought we were pretty weird though," Ron remembers. "Here were these two black guys — a student and an engineer — building things in a basement and asking him for money. He told us that to start selling amps the way we wanted to we'd need $100,000. But then he asked us about putting up equity and we didn't have anything, so he turned us down for the $100,000. We told him that if we could just have like $10,000, we could produce more amps and build some equity. But he said no, we were obviously undercapitalized, and we couldn't make it no matter what if we were undercapitalized. Which seemed like circular logic to me."

Dunlap and Clarke spent two years building their units one by one and selling them wherever thay could. The Dreadnaughts made a minor splash at the Consumer Electronics Show in Chicago, but except for technical advances, most of which were unrelated to actual sound reproduction, the company was stagnating.

Dunlap Gets Even

In June of 1974, Dunlap finished his internship. This cut his workload down to a mere 100-hour week as a resident at Cambridge City Hospital. By Ron's standards, he now had enough spare time to increase production. Ron says, "If I'd gone into business when I first started building amps, I'd have been one of three high-power amp companies in existence. Already we're one of nine."

Dunlap Clarke contracted out the manufacture of the Dreadnaughts to an independent shop called Liberty Engineering, Inc. Liberty is a small business housed in a cooperatively owned building off Route 128 in Needham. It's a strange place. There's a clothing outlet down the hall and next door to the Liberty shop, somebody is building a laser beam. Liberty Engineering creates no product of its own but will design, engineer and build other people's gadgets. It's the last refuge for the private inventor in a world of corporation think-tanks.

Wandering into the cluttered workroom — cluttered with Dreadnaught chassis and components — Ron can't resist poking around the latest gizmos. The sound of the hacksaw cutting through heavy metal filters in from the room with the laser beam. Ron picks up a half-assembled 4"x4" metal box and peers inside at the miniature circuit boards and the tangle of wires. It's some other visionary's bid for the better mousetrap.

"Look at that," he says with reverence. "There's hardly anything inside here. Of course, that's what people always say when they look inside our amps. Yeah, there's nothing in here, nothing but some guy's brains."

With additional labor and assembly line time from Liberty, Dunlap Clarke will soon have a production capability of 20 to 25 amplifiers a month. From the looks of it, they won't have any trouble moving the inventory. Stereo stores around the East and even throughout the yet unexplored Midwest and West Coast are begging to carry the Dreadnaught 1000, Dunlap's 1000-watt amp. A promotional brochure is in the works. Dunlap Clarke now retains an ad agency and a sales promoter.

The high end of the stereo market is a world of its own, totally unrelated to the petty horse-trading down at the consumer level. Those of us whose fondest dreams are realized by a 70-watt Marantz have trouble understanding why anyone would want to own a unit that delivers more audible power than our mundane ears are equipped to tolerate.

When the laser mechanic quiets down, Ron explains: "Some people will buy these for their homes, although we're not about to suggest that our amp is something that everyone needs. Professionals use them for voice amps. What the power's really good for is driving multiple speaker systems — in restaurants or large homes. We've hooked up as many as eight speakers to one unit without its overloading."

Ron feels that there's still room for one more in the admittedly specialized high-end market. "People keep wanting us to design a 70- or a 100-watt version for home use, but we just don't have a big enough name to make it in that market. As it is, one of our big problems has been that some people can't believe that we can design anything that the big companies can't. I don't want to sell our units by putting down other high-power amplifiers. We think we have a good product that's right up to date with technology, and the customers can find that out when they hear it."

Making It

Right now, it's interesting to observe Dunlap and his company in transition. On the one hand, they're about to make their big marketing push, but on the other, Ron still knows each of his amplifiers personally. He can walk around the Liberty Engineering shop and point to any one and say, "I built this one myself," or "this is one of our first production units."

The personal touch is still there. Ron is a solder freak. He hates cold solder joints, especially within monsters where bad metal can make the difference between peak performance and a smoking disaster. So he goes over the mass-produced circuit boards himself and fortifies any suspicious connections.

Dunlap can't stand the thought that his business is getting out of hand. He worries about each Dreadnaught like a mother hen. So-and-so over in Brighton has one; maybe, Dunlap thinks, he should call up and get it back. Over in the corner Ron is rebuilding two older amps to sell to friends. He likes to keep track of things and dreads the day he'll have too many things to keep track of.

He speculates: "If you're the type of person who wants to make money, eventually your pet project is going to be taken away from you. We've had offers from various big companies along the line. Maybe we were stupid not to sell out, but I really enjoy building amps and I can't let the fun part get away from me. I like the freedom of making only a few at a time. No matter how much money you're making, it's terrible to be in a position where somebody else is telling you what to do."

Impending success, which means playing in a bigger arena, does seem to make Dunlap nervous. This fellow from Newark who claims to have gone to college as an afterthought — his high school allegiance was to sports — now finds himself juggling two professional careers. He's having trouble adjusting to the idea that his company has just invested $25,000 in electronic parts.

So far, Ron has done a remarkable job accommodating his medical and business careers. "Sometimes," he says, "I find it a little strange that one hour I'm out here checking transistors and the same day I'm in the emergency room with people bleeding all over me, but I can turn myself on and off." (This double life has occasionally led to some funny coincidences. During his internship, Ron once had Winslow Burhoe, founder of EPI, as a patient.)

Now, Ron's prepared to finish his residency and spend a year devoting his full energies to Dreadnaughts. Whatever happens, Ron is always going to seem most at home — at home, down in his dank new little basement, like the one where it all began. A colorful place that basement, overflowing with stacks of forgotten inventory and undiscarded pieces of early prototypes. A romantic scene with the traditional bare bulb and a cluster of hand-built test equipment scavenged from Eli Heffron's famous electronics flea market. "I just about have as much stuff here as they have out at the shop. I guess we went out there because it's bigger and easier."

He's sort of sorry he left. What's going to make Ron happy is when he starts on his next project.

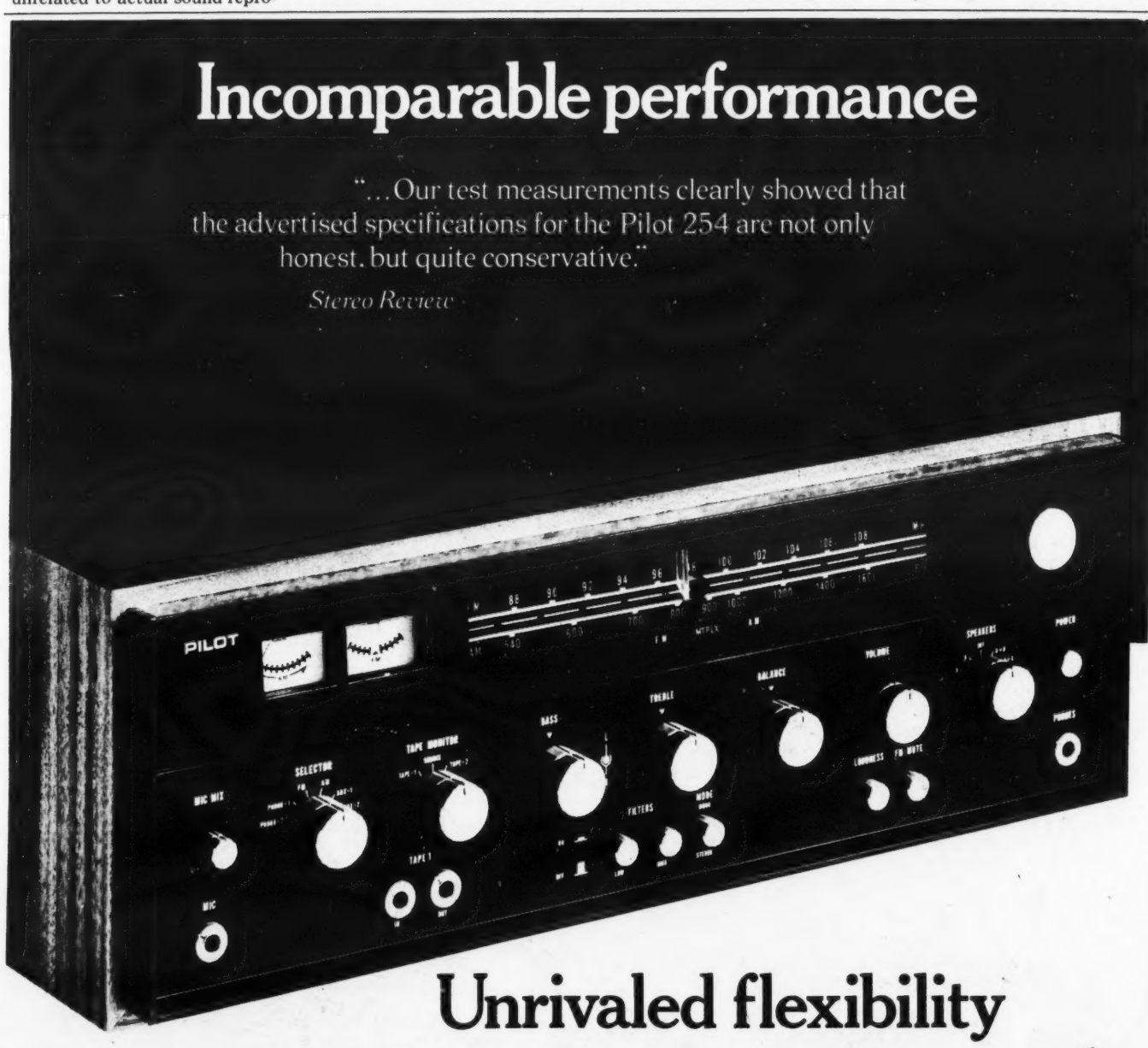
*

The Dreadnaught puts out 500 watts per channel. It sells at around a dollar a watt. At the very least, you can tell the Mamma from the Pappas with this amp. It is not one of your typical cottage industry products, but then Ron Dunlap isn't one of your typical cottage craftsmen. For his next miracle Dunlap is planning a matching pre-amp. After that, who knows? Maybe he'll remodel his basement.

Incomparable performance

"...Our test measurements clearly showed that the advertised specifications for the Pilot 254 are not only honest, but quite conservative."

Stereo Review



Unrivaled flexibility

"...this is a very solidly designed receiver and one that—because of its extra phono, tape, and aux inputs—has the extra measure of hookup flexibility that is fast becoming a necessity now that system owners are thinking in terms of more than one tape format, the possibility of quadriphonic conversion, and similarly demanding uses."

High Fidelity

PILOT

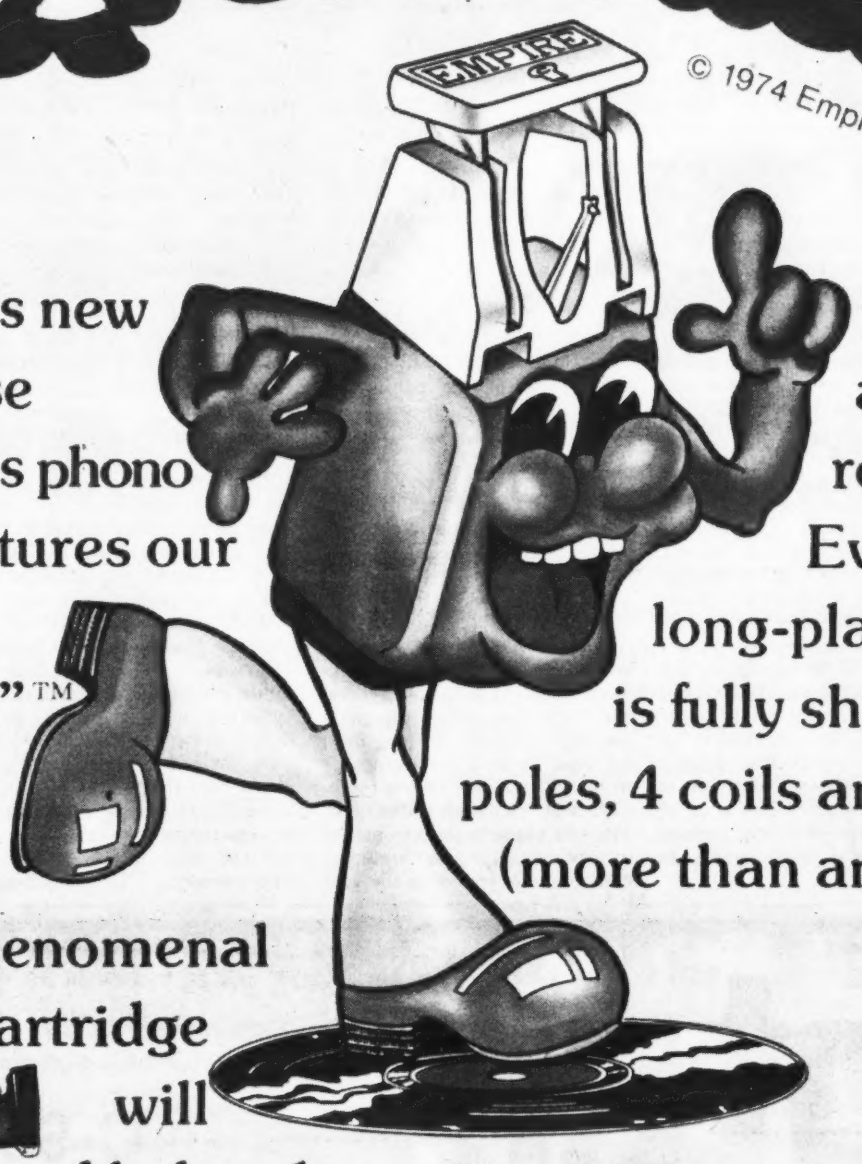
performance is more than great specs

The Pilot 254 Stereo Receiver

For the complete text of these reports and additional information write: Pilot, 165 West Putnam Avenue, Greenwich, Conn. 06830.

keep on trackin'

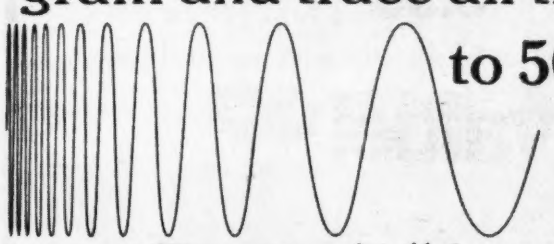
© 1974 Empire Scientific Corp.

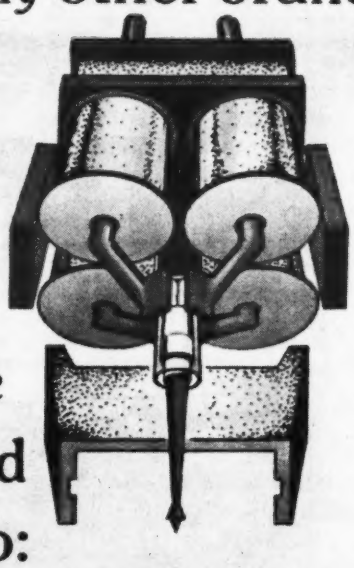


Empire's new wide response 4000D* series phono cartridge features our exclusive "4 Dimensional"™ diamond stylus tip.

ing prevents any discernible record wear. Every Empire long-playing cartridge is fully shielded with 4 poles, 4 coils and 3 magnets (more than any other brand).

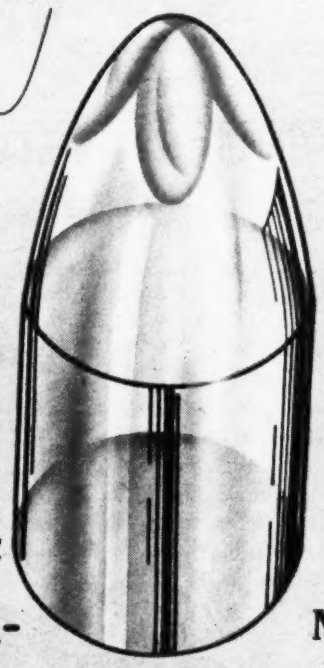
This phenomenal cartridge will track any record below 1 gram and trace all the way to 50,000 Hz.





For a free Guide to Sound Design write to:
EMPIRE SCIENTIFIC CORP.
Garden City,
N.Y. 11530.

Empire's "4 Dimensional"™ diamond has a 0.1 mil radius of engagement yet the very low force required for track-



Mfd. U.S.A. EMPIRE

* Plays *any* 4 channel system perfectly. Plays stereo even better than before.

Woofing It

How to fish for bass

By Roy F. Allison

Every loudspeaker system must have at least one woofer to generate low-frequency sounds. Bass speakers may be small or large, may cover only a fraction of the audio-frequency range or all of it, can vary drastically in number and shape, and may be driven by either electromagnetic or electrostatic force. All of them, however, produce low-frequency sound by essentially the same means: the straight-line vibratory motion of a diaphragm.

Nevertheless, there are significant differences among bass reproducers. These differences have to do with how the vibrations are coupled to the listening environment — in other words, what kind of enclosure is used — and with what kind of signal processing (if any) is required as an adjunct of the enclosure design.

An unmounted speaker is practically useless as a woofer. Both the front and rear of the diaphragm are open to the surrounding air. While the front surface of the diaphragm is trying to compress air by moving forward, the rear surface is trying to rarefy the air behind it. At low frequencies, the diaphragm doesn't move fast enough to keep these processes separate; air from the front flows around the edge of the speaker, thereby decompressing itself and filling in the vacuum at the rear of the diaphragm. When the cone moves backwards, the air flows around the edge of the diaphragm in the opposite direction. The cone motion is thus short-circuited and produces hardly any net bass energy.

It is easy to see that this front-to-back interference can be limited by mounting the speaker on a baffle — a large flat board, for example. When we do this we make a *dipole radiator*: one which radiates equally but in opposite phase on its opposite sides. Panel-shaped speaker systems (primarily electrostatic, but some electromagnetic models too) fall into this category. In many of these systems nearly the entire panel is made up of bass diaphragms; the baffle is the radiator also. Such a dipole speaker is effective down to a frequency for which its minimum dimension is equal to half a wave length of sound energy. If the panel's minimum dimension is three feet, for example, there will be little self-cancelation of bass frequencies above about 200 Hz. Below this frequency and down to the fundamental resonance frequency of the system, the output falls off at six db per octave. Below resonance the response falls at 18 db per octave.

Complete isolation of the front and rear sides of a woofer diaphragm is obtained if we mount the woofer in one panel of a closed cabinet having no other holes in it. If the cabinet is very large, it has the same effect as a flat baffle of infinitely large dimensions; such a cabinet is, indeed, often called an *infinite baffle* enclosure. Enclosures of this kind (with volumes of 10 cubic feet or more), once popular in monaural days, are now quite rare.

In 1954, an improved version of the closed-box enclosure, which happened to be of small size, was developed by Edgar Villchur. This *acoustic suspension* design now is used in a large majority of all loudspeaker systems on the market. The normal range of sizes is from about one-half to two cubic feet internal volume. With proper design the response under ideal conditions is flat down to the resonance frequency, and falls below that frequency at 12 db per octave.

An alternative to the closed-box enclosure is the *bass reflex* or *phase inverter* system. In its pure form it is a box with mounting holes for the speakers plus another vent (port) hole. Often there is a short duct leading inside the cabinet from the vent, especially when the cabinet is small. With proper design of the woofer and of the cabinet, a vent/cabinet resonance is established just below the woofer resonance frequency. The vent output reinforces and extends the woofer output significantly. If everything is adjusted optimally, the low-frequency performance of a bass-reflex system can be made just as flat as that of an acoustic suspension system, although its response below the vent resonance frequency falls at 18 db per octave. The best bass-reflex design is also the simplest. Nothing need be used inside the box except some lining on the panels to absorb high-frequency reflections. Variants of the basic system that incorporate damping materials behind the woofer or in the vent are inefficient designs, in the sense that some aspect of low-frequency performance is needlessly compromised by the presence of the acoustical damping material.

A lot of publicity has been given recently to another variant of bass-reflex design, called the venturi. In fact, the venturi opening is a ducted vent. Any bass-reflex vent — including a "venturi" type — can be tuned so that the cabinet resonance frequency is far below that of the woofer. As a result of this mistuning, the vent output is substantially lower in amplitude than the woofer, and the response of the system has a distinct low-frequency slope.

There is a legitimate variation on the basic bass-reflex theme. It is the *drone-cone* or *passive-radiator* system, in which the vent is replaced by a non-driven speaker diaphragm (a "vent substitute," as one manufacturer calls it). The diaphragm covering the vent hole is very loosely suspended. When the design of the system requires a very large mass of air to be vibrated in the vent for proper cabinet tuning, it is occasionally not feasible to realize the design even with a long duct for the vent. In such a case the passive radiator (which can be made to have any desired value of mass) is useful. This system can be made to have nearly as high a figure of merit as the basic bass-reflex design. What does the "figure of merit" signify? Not flatness of response, or low-frequency extension, or cabinet size, but a constant, representing the efficiency theoretically achievable with a particular system design. Thus it can be compared with other kinds of systems having equivalent size and frequency response.

In very general terms, good bass-reflex systems have a figure of merit twice that of closed-box systems. That is to say, if the two cabinets are equal in size and the low-frequency responses are identical down to the cutoff frequency, the output of a bass-reflex design will be three db higher than that of a closed-box system for the same input power. Consequently, an amplifier of twice the power capability would be needed to drive an acoustic-suspension system to the same output level as an "equivalent" bass-reflex system. Of course there are compensating disadvantages of the bass-reflex system (otherwise, no one would make closed-box systems). One is the fact that, below the cutoff frequency, bass-reflex output drops faster and the transient response is worse. (Probably that is not of any audible significance.) Another problem is in manufacturing control requirements, which are tougher for the bass-reflex system if the same response tolerances are to be held. Finally, in a bass-reflex system, the woofer is unprotected by enclosed air stiffness below the vent resonance frequency. Therefore, it is more vulnerable to low-frequency pulses from the amplifier than is the woofer of a closed-box system.

For both types of system the

Continued on page 34

Scotch®
BRAND

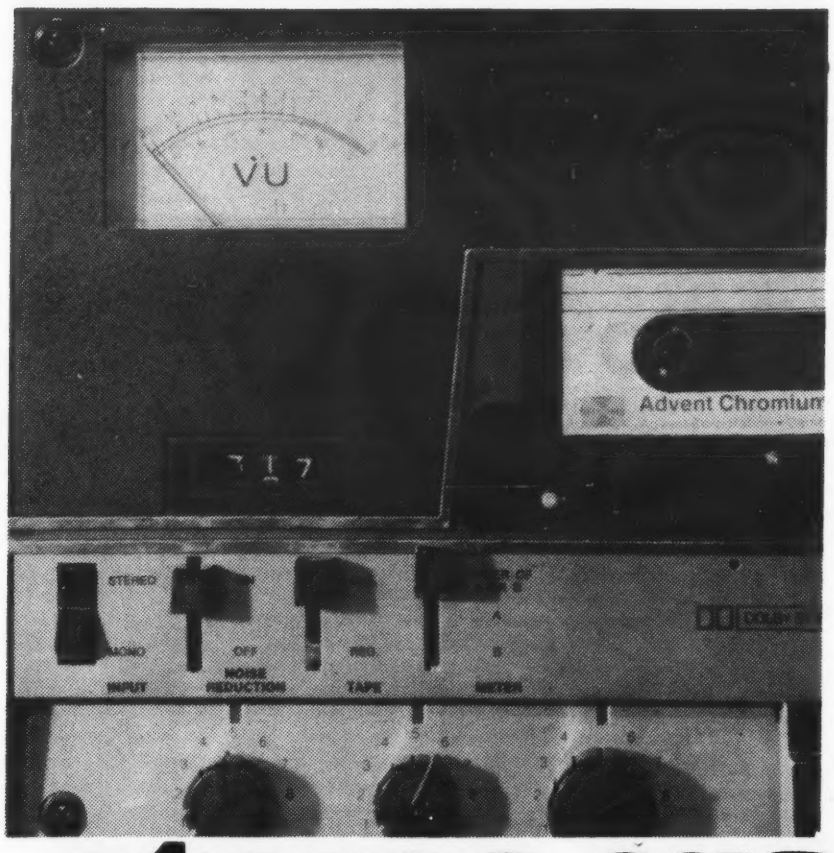
C-90
SALE PRICE
$3.99

value!

From 3M Company, a cassette value that won't quit... Dependable performance with a high quality, low-noise tape from the originators of low-noise tapes.

the Coop

MIT Student Center
HARVARD SQUARE
Childrens Hospital Medical Center



Why you should buy the Advent 201 stereo cassette deck.

The Advent 201 stereo cassette deck combines the high fidelity performance of open-reel tape decks with the greater convenience of the cassette format. It incorporates the Dolby Noise Reduction System, special playback equalization for the new Chromium Dioxide tapes, and an extremely rugged, American-made tape transport mechanism (Advent makes the electronics themselves!)

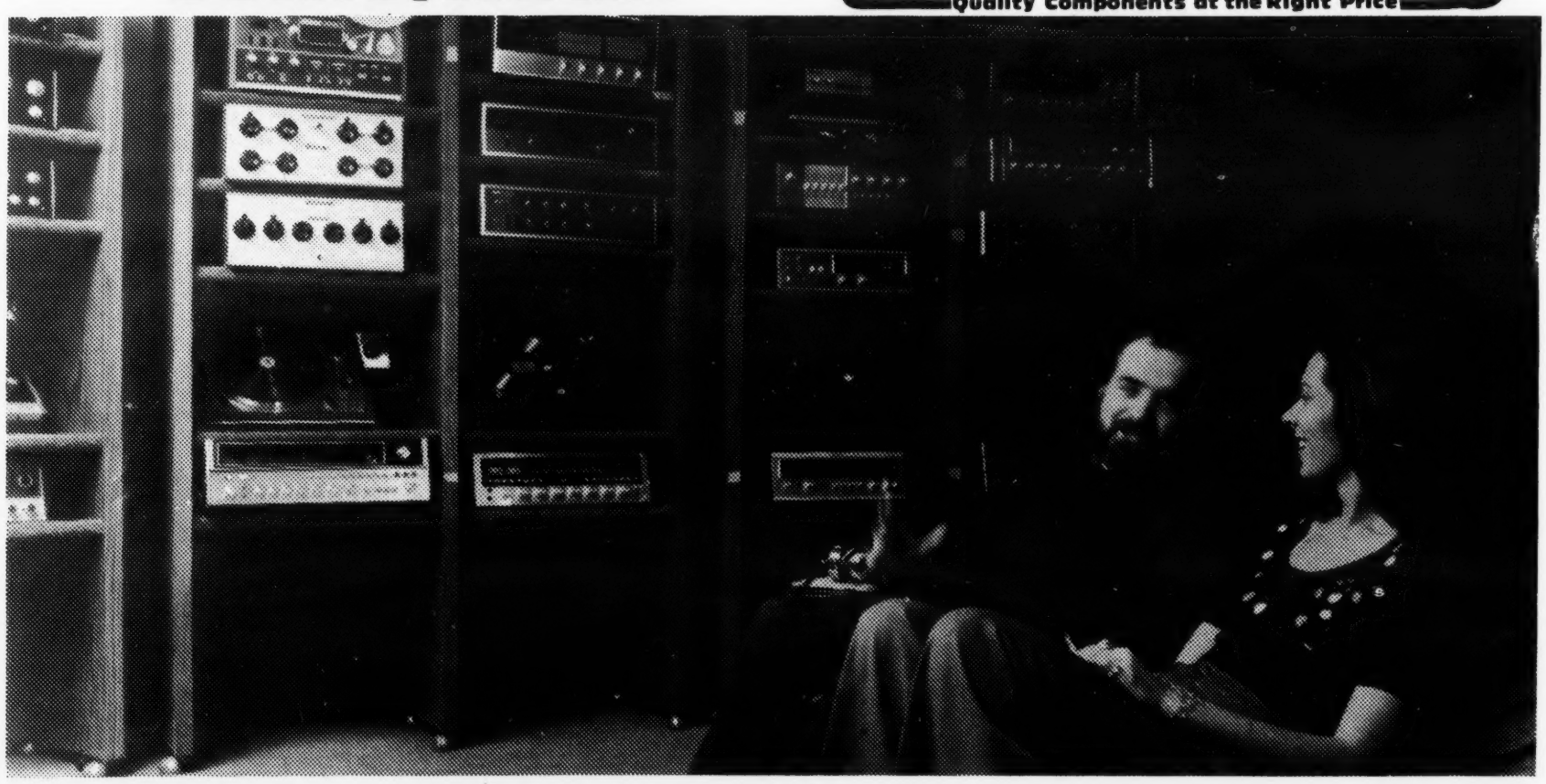
The Advent 201 can make cassette recordings that are *indistinguishable* from the source, whether it's a phono record, FM stereo broadcast or another tape. So with the Advent 201 you can put together a serious music collection for a fraction of what you'd spend for records. And unlike records, cassettes can be played over and over without deterioration!

Why you should buy it at Tech Hifi.

Making high quality home recordings on the Advent 201 is surprisingly easy... once you've mastered some simple techniques. So when you buy one of these excellent cassette decks at Tech Hifi, we'll take the time to explain everything you need to know. We'll show you how to hook the Advent 201 into your system, how to set recording levels with the Advent's single VU meter, and how to maintain the tape heads for maximum performance. We can recommend the best tapes to use with the Advent 201 and even tell you where you can get the highest quality pre-recorded tapes to play through your new deck. We want you to get the most out of the audio equipment you buy at Tech Hifi.

Come, hear.

tech hifi
Quality Components at the Right Price



Ode to a Boston Fern:

By Jeffrey S. Linder

Cleve Backster, the nation's foremost polygraph (lie detector) expert and former CIA interrogation specialist, was watering his office plant one day. "I was trying to measure how fast water rose from the roots into the leaf," Backster says.

"Well," he explains, "I got off the track a little."

Backster connected two electrodes hooked to a galvanometer (which measures electrical resistance) to the top and underside of a dracena plant leaf. He expected the galvanometer needle to register an upward swing as the leaf filled with water and electrical resistance decreased. Instead, the needle went down. "After one minute of chart time," Backster says, "The tracing exhibited a contour similar to a reaction pattern typical of a human subject experiencing an emotional stimulation of short duration." Was that dracena plant feeling something? Drinking, could it have felt relief?

What if a leaf is burnt? Backster thought. At that instant, the needle jumped. And when he actually stood up with the intention of finding a match, the needle jumped even higher. The plant seemed to know just what Backster was thinking. The plant responded to the "mere thought of harm [I] intended to inflict," he hypothesized. It was as if the plant had ESP! Risking undue anthropocentrism, one could gather from Backster's experiment that plants have feelings. They may register fear, apprehension, distress and happiness.

The notion that plants are sentient is given provocative documentation by Christopher Bird and Peter Tompkins in *The Secret Life of Plants*. Bird and Tompkins call Backster's findings the "Backster Effect." The Backster Research Foundation in San Diego found the "Backster Effect" to occur in fruits and vegetables, mold cultures, yeasts, human mouth scrapings, blood samples and even human sperm.

The door had been opened. We may now ask ourselves with a degree of seriousness whether there is the possibility of a "life forcefield." Those at Sounds Reasonable, Inc. seem to think so. At this Washington, D.C.-based recording studio, Ed Barnett and Norman Lederman used the "Backster Effect" to derive sound from plants. Not just sound, but also song.

Sounds Reasonable use two electrodes the same way Backster did. Here, the electrodes are made of gold because, as audio engineer Lederman says, gold is a super conductor. The electrodes are then connected to a specially designed plant-amplifier. The special amp is hooked to an ARP music synthesizer. When the plant is subjected to stimuli, it triggers the synthesizer. What is produced is a kind of music. Plant music.

At a plant concert at Sounds Reasonable last spring, someone walked up to the coleus wired to sing, held a knife high in the air and told the plants, which were making faint shrieks, "If you don't perk up, I'll slit your throat." Apparently terrified, the plants shut up altogether.

Local TV and radio stations were invited to a plant concert by Sounds Reasonable PR man Chris Sayer. "We did all kinds of things to make the plants react," Sayer says. "A light man from WMAL liked to grow and pick tomatoes. When he approached the plant, it went a bit crazy. We offered a lily a tuna sandwich. It yelled at us."

Sounds Reasonable has been so enthusiastic about their idea that they cut a 45 rpm last April of a "stereofernic orchidstra." "We get letters from around the world asking for copies of our plant recording. We give them out as business cards," says Barnett.

Sayer describes the record as a "non-smash hit," but full of po-

David Krathwohl

Dennis Colin attaches electrodes to the leaves of a philodendron in order to test the plant's ability to use biofeedback to regulate its supply of light.

Rock with the Wizard and the Pioneer Rock Standard System for $429.

The **Pioneer Rock Standard loudspeaker** is not your average speaker! Why? Because it was designed *specifically* for rock and roll music, and it reproduces rock and roll with a clarity and immediacy that you've probably never heard before. It's got a Pioneer exclusive Carbon Fiber Woofer that gives much better transient response than other woofers its size, and the Rock Standard never has to sacrifice deep bass for efficiency. It plays rock music good and loud, without exaggerating the high end or the low end. But what's best of all is its price. Pioneer has designed the Rock Standard so that it will be available in low to medium priced hi-fi systems.

The Wizard of Atlantis got the Rock Standard speakers together with another high performance product from Pioneer, the **Sound Project Model 300 AM/FM stereo receiver.** And because the Rock Standards are so efficient, this receiver has more than ample power to drive the Rock Standards to those all-important high levels.

And for your records, the Wizard offers the **BSR 2310X,** the highly reliable changer designed to pamper your record collection.

So sit down and treat yourself to some good rock sound from Led Zepplin to the Average White Band. The Wizard's Pioneer Rock Standard stereo system wants to perform for you!

Atlantis Sound

Harvard Square, 38 Brattle St., 661-3100; **Prudential,** 811 Boylston St., 261-2788; **Allston,** 1092 Comm. Ave., 731-5700; **Framingham,** 248 Worcester Rd., Rt. 9 East, 879-6550; **Peabody,** 10 Sylvan St., 531-8888; **Braintree,** South Shore Plaza, 843-2600; **Worcester,** 328 Main St., 757-7700; **Providence,** 261 Thayer St., 831-1900; **New Haven,** 31 Broadway, 772-0000. *Stores also in New York, New Jersey, Maryland, Washington, D.C., Virginia and North Carolina.*

Experimenting With the Beet Generation

David Krathwohl

Voltage fluctuations from electrodes then cause changes in light intensity.

tential. Atlantic Records first appeared interested in the notion of a commercially produced album of plant music. But they never followed up the idea because, as Lederman explains, the "electronic public couldn't relate to it. If we took the same principle and had plants modulate the sounds of human voices or a piano, then I think Atlantic might be interested."

Lederman's scheme involves the use of closed loop tapes (which are like eight-track tapes). The closed loop tapes will be pre-recorded with violins, a piano or human voices. The plants will send out their electrical impulses, producing sounds on the synthesizer and modifying the speed of the variable speed tape recorder so that the pre-recorded music on the closed loop tapes will arrive at the same pitch as the synthesizer's musings. A plant-controlled concert.

These plants send out tiny electrical impulses measured in microvolts. The electrical output from the plant is one millionth the output from a stereo turntable needle. These very small electrical impulses must be amplified to produce the one or two volts needed to drive the synthesizer. The sounds from the synthesizer are controlled by the amount of electricity from the plant. These sounds have been described as "weird ethereal chirpings and shriekings with no rhythm or linear kind of beat that could be measured in any way."

Witnesses express wonder at what they hear. Plants that communicate? "We just sit around with some friends, get high and listen to the plants," says Barnett.

Lederman gave a plant concert last spring at American University. "The plants went bananas," he says. He attributes their increased activity to the large audience. "The actual changes are amazing. People came up and said they felt responsible for the changes they were hearing."

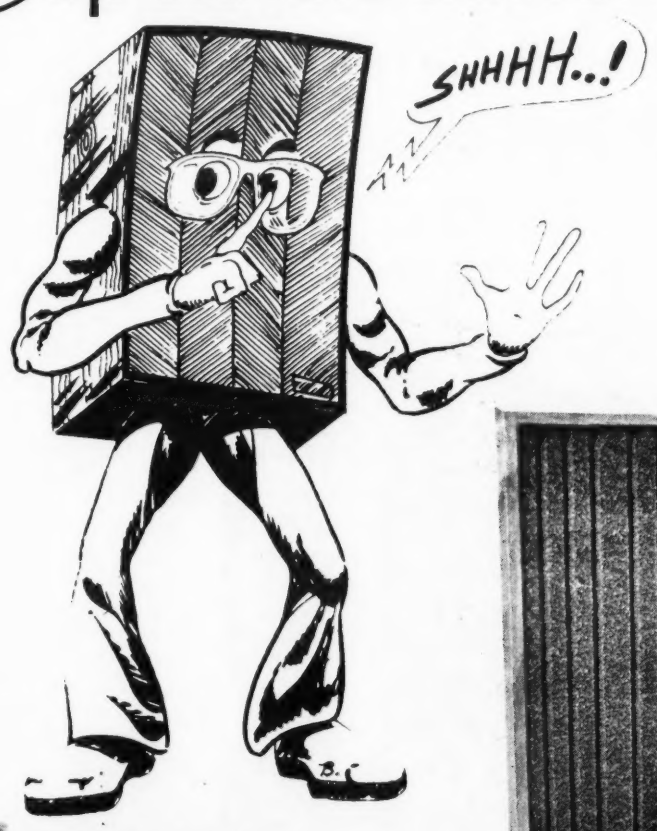
Can plants actually sing?

Dennis Colin, an independent electrical engineer in Beverly, attempted to duplicate Sounds Reasonable's plant music. In his low-ceilinged apartment he connected a philodendron and then a pepperomia to an ARP synthesizer. The plant's reactions could be measured through the synthesizer and also an oscilloscope. The lights were dimmed to create atmosphere in the room. The plants react to atmosphere, or if not to atmosphere, to the emotional state of human beings nearby.

Continued on page 16

"After a minute the tracing exhibited a contour similar to a reaction pattern typical of a human subject experiencing an emotional stimulation of short duration. Was that dracena feeling something? Could it have felt relief?"

These BMI speakers don't make any noise!



The Quiet Mover.

BMI has become known in the trade as *"The Quiet Mover."* Quietly, they have been sold for years. Why? We have told our dealers to simply play **BMI** next to the more widely advertised speakers in the same price and performance range. We want the consumer to be the judge.

There are many **BMI** speaker systems in the dorms, apartments, schools, and offices of your town. Ask a friend who owns a pair to play them for you or go to one of our exclusive dealers. You'll find out what makes a *"quiet mover"* move.

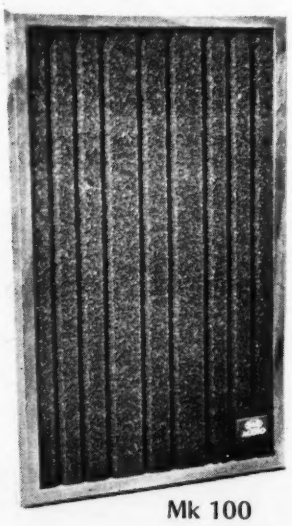
But they make a lot of sense.

—**BMI** produces a full line with sizes and capabilities for any system.

—**BMI's** are so well put together that we can fully guarantee them for five years.

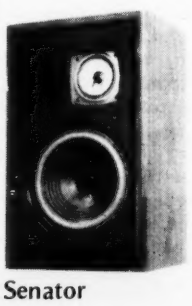
—**BMI** is called *"The Quiet Mover"* because our dealers let the big names make all the noise, then sell the **BMI** sound featuring rich bass and dynamic high end transparancy.

—**BMI** manufactures an efficient speaker system. **BMI** speakers are extremely versatile. They match well with any amplifier or receiver . . . high end or low end. Therefore, you can match them with your present receiver or amplifier, or with your dream choice of the future.



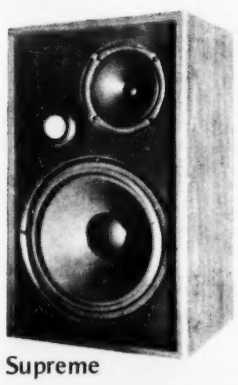
Mk 100

Mk 99



Senator

President



Supreme

*Dealer inquiries welcome.
Contact your nearest distributor.

Distributed by:

Allbrand Components
4150 22nd Street
Long Island City, NY
(212) 937-3600

ABCO Wholesalers, Inc.
915 Grand Avenue
New Haven, CT
(203) 777-7881

Brands Midwest
1725 East 8th Street
Kansas City, MO 64106
(816) 471-7393

LOCAL DISTRIBUTOR
BRANDS MART
280 Friends Street
Boston, MA
(617) 742-2030

FAD Components
20 Passaic Avenue
Fairfield, NJ
(210) 277-6814

Brands Mart of Deer Park
160 E. Industry Ct.
Deer Park, Long Island, NY
(516) 586-2003

David Kraftwohl

Experimenting in the dark

Fern

Continued from page 15

(There have also been experiments conducted by Denver housewife Dorothy Retallack. She discovered that plants react best to "easy listening" music and become stunted by rock.)

Colin created a relaxed atmosphere without any music. He used silver electrodes and KY lubricating jelly on the philodendron to pick up the plant's electrical impulses. He connected the electrodes to a low-frequency amplifier, multiplying the plant's electrical impulses 300,000 times as opposed to the one or two million times at Sounds Reasonable. The result was a bizarre sort of hum. Colin gave up on the philodendron. It probably wasn't used to the surroundings, he thought. Perhaps, it was shy, or modest. It wouldn't sing, and we'll never know why.

Colin connected the pepperomia. It reacted better instantly. Occasionally, there would be a random jump in sound from the synthesizer. Colin could not say why. His wife, Elaine, walked in with no introduction to the experiment. "It sounds like someone's talking to us," she said.

The plant's owner, the person who knew the plant best, went over to provoke the plant in some way. Impulsively, he picked off a brown leaf. The sounds suddenly stopped. It was a fleeting moment, hardly recognized by the spectators, but it happened.

Colin refused to say the experiment was a failure. But it wasn't a success either. He touched the electrodes to the BLT sandwhich in his hand. It sang the same as the plants. The sandwich didn't seem to mind that it was half-eaten.

"One more thing," Colin announced. He connected the electrodes to a band and slipped it over his head so that the electrodes were touching his forehead. The song changed. It was smoother. The synthesizer registered every move Colin made.

This was not a very scientific experiment. But researcher David Rosenbloom of York University in Toronto has been using synthesizers to "understand the relationship between brain waves and the [musical] environment." This kind of research was performed at Brandeis in 1965 by Alvin Lucier. He used alpha brain waves, a super high-gain amplifier (much like Colin's amp) and an oscillator (a sound-modifying instrument ablt to produce pure tones) to generate sounds. "Sounds can also be obtained from ankles," according to Ivan Tcherepnin, a French composer teaching at Harvard. He mentions the possibility of using body heat to make a kind of music with the aid of a synthesizer.

A Harvard graduate student in electronic music, Martin Yaffee, described a way in which hand-squeezing could create sounds through the synthesizer. People sit in a circle holding hands, each with an earring in one ear, the earrings connected to an oscillator, According to how hard or soft the left and right hands are squeezed, the volume and color (timbre) are controlled, respectively. Tcherepnin explained that he has monitored natural rhythms before. He gave clouds vocal chords two years ago. Using light-sensitive photo-electric cells and an oscillator. Tcherepnin recorded in sound the shifts in light that clouds make as they rush by over head. "It's like listening to clouds," Tcherepnin says. "It's really relaxing, hypnotizing, listening to the soft rhythm of change. The clouds don't make the sounds; they shape the sounds. It's nice."

In every sense the Infinity Column is an extraordinary speaker system.

It has our exotic, patented Wave Transmission Line tweeter, the first transient-perfect, totally coherent 360° tweeter in the world.† It has two additional midrange tweeters, one rear-mounted for ambience; as well as our two patented woofers, one down-mounted, in their Active Transmission Line enclosures.

It has an extraordinarily flat frequency response, giving you *natural,* accurate orchestral timbres. Both acoustic and electronic instruments are reproduced with extraordinary accuracy—free from the "bumped-up" mid-bass and mid-highs that characterize the artificial sound of many much more expensive systems. And you don't need Boulder Dam to drive it.

This means that whether your head is into rock, classics, jazz or country—or all of them—this is the full, clear, accurate sound of the *orchestra;* not an electronically-goosed approximation of the orchestra.

And the Column has an extraordinarily low price.

At $239* each, run, don't walk.

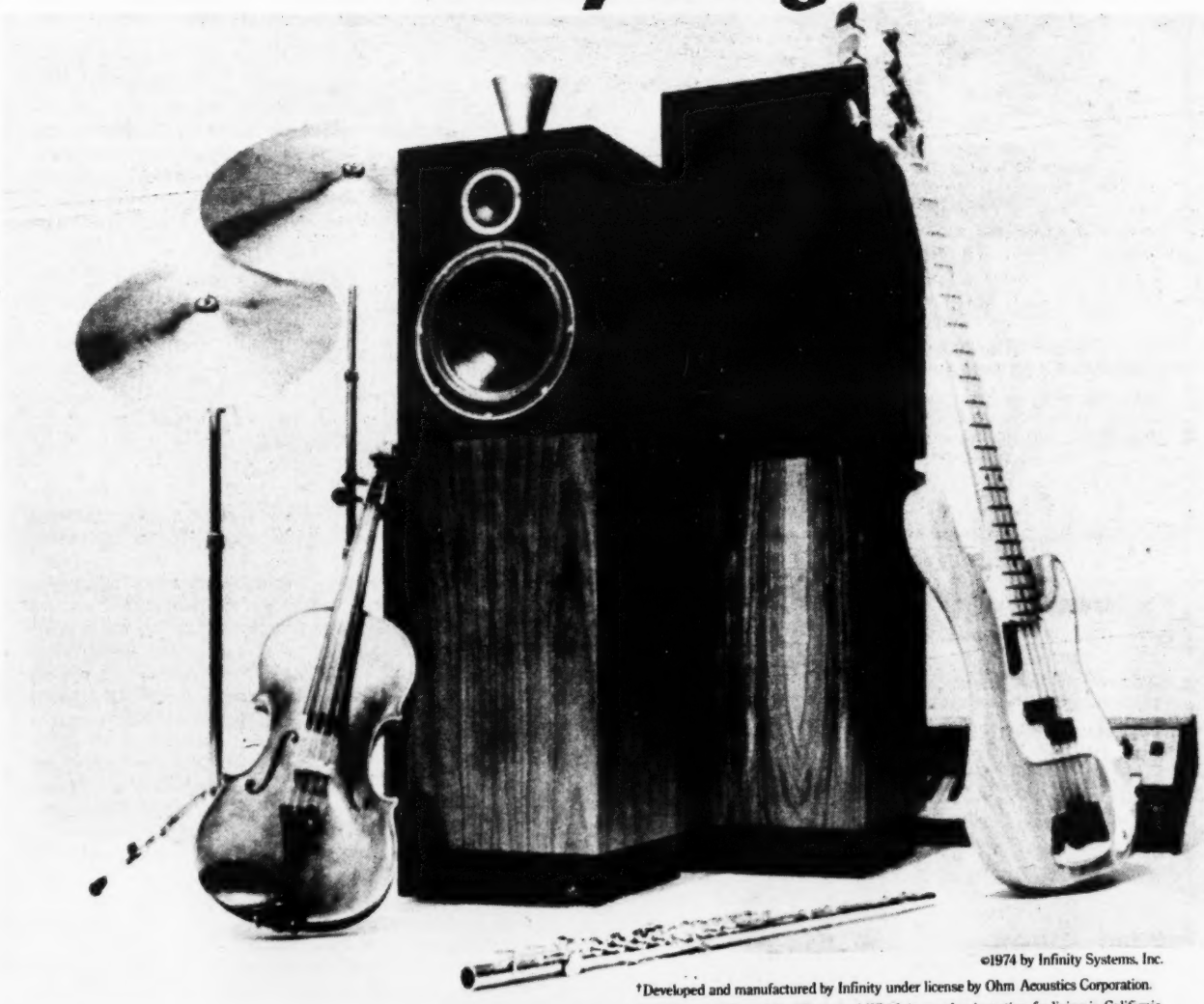
INFINITY SYSTEMS, INC.

We get you back to what it's all about. Music.

9001 Fullbright Ave., Chatsworth, Calif. 91311

Introducing Infinity's Wave Transmission Line Column

For those who only want everything



©1974 by Infinity Systems, Inc.

†Developed and manufactured by Infinity under license by Ohm Acoustics Corporation.

*Slightly more East of the Mississippi. Which is an other incentive for living in California.

Cary Cochrane

OTHER ERAS, OTHER EARS

By Robert Long

You remember 78s. Sure you do; they were those heavy, breakable records that used to slap down with a tooth-jarring whack when you stacked them on a changer. They were the kind of records that emitted a gritty hiss along with the music — enough to sound like jet-engine noise next to the glider quiet of a good LP. They were the discs that parcelled out any music, however extended, into four-minute chunks and seemed to expect a state of suspended animation in the sensibilities of the listener while the arm whisked back, the next record clattered down and the music picked up where it left off.

Or almost where it left off. That's one of the many fascinations with playing the old discs, despite their fabled (and not entirely deserved) reputation for substandardness in today's hi-fi world. The performer, aware that the listener could not hear his delicately turned cantilena as one continuous arch, might do one of several things when the appointed spot for the side-end approached. He might arbitrarily insert a cadence of sorts — usually, a ritard that would lend a sense of semi-finality and mitigate the awkwardness of the interruption. He might pull the music apart a bit so that the end of the first side seemed fairly complete, while the beginning of the next seemed to take off from a logical starting place. Often, this technique was required by a chord on the beat that doubled at the end of one phrase and the beginning of the next. When that happened, the performer might, alternatively, simply repeat the whole chord on the second side.

Toscanini sometimes took the opposite extreme. It was his NBC Symphony set of the "Eroica," I think, that bears most disturbing witness to his disdain for the medium. The story is told that he lost patience with the start-stop technique imposed by the 78 side and announced that he and the orchestra would play through the score. If the Victor engineers chose to record the performance, that was their business — and so was the managing of the side breaks.

"[Toscanini's* Eroica*] is one performance of the 78 era that reconstitutes itself as readily as orange-juice concentrate. It is, however, the exception, because Toscanini deliberately violated the medium in which he was working. Few performers had the temerity to try — much less to get away with — that."

The engineers' solution was simply to do their best, which for my ears wasn't very good. With side one a-cutting and the wax (acetate?) masters for side two already in place on the disc lathes, they waited anxiously for a cue to switch the feed from the one side to the other. As it approached, they started the side-two lathes (I assume they cut at least two masters simultaneously for protection) and lowered the cutterheads to the master blanks. When the cue came, they flipped the switch and then raised the side-one cutters.

This is all supposition, but the evidence is there. When you listen to side one, you find that it suddenly goes dead in mid-note. The record plays on silently (except for surface-noise) for a cou-

Continued on page 18

Eras

Continued from page 17

ple of seconds, then whooshes into the leadout groove, and you're ready for side two. But despite the rude interruption you suffered at the end of side one, side two seems in no hurry to bring you back to Beethoven. It grinds on for several turns before the truncated note is finally completed. The performance probably does have a power and drive that it might not have attained had Toscanini and his men recorded it piecemeal, but since you must listen to it piecemeal, that continuity defies mental reconstruction.

But not reconstruction on tape or LP. Whether you're a home tape freak (like me) or a collector of reissues (also, to a lesser extent, like me), this is one performance of the 78 era that reconstitutes itself as readily as orange-juice concentrate. It is, however, the exception, and it is so because Toscanini deliberately violated the medium in which he, as a recording artist, was working. Few performers had the temerity to try — much less to get away with — that.

In pops, of course, the 78-side's time tyranny had much less effect. Most performers seemed to feel entirely comfortable with the (approximately) three-minute limit of the 10-inch side. There were exceptions. Some of the lusher arrangements showed up on 12-inch sides. Bessie Smith did at least one number ("Empty Bed Blues") that took two 12-inch sides. So did Duke Ellington — who eventually got into whole suites that, like most classics except the encore variety, required more than one disc. But pops — which, by definition, is ephemeral — tends to be cut to the available cloth as well as the available market.

As were some classics. It is said that Puccini consciously avoided any musical structure that could not be recorded on a single 78 side. (Perhaps, he never dreamed that the love duets from *Tosca* and *Butterfly* would be recorded, but I think the existence of those over-four-minute passages undermines the legend of Puccini's phonographilia.) Charpentier boiled down the score of *Louise* to a special edition for the phonograph. And, of course, the classics that were adapted for the phonograph by hands other than the composers' are legion.

When the phonograph was in its infancy, those hands sometimes were brutal. Would you believe the *William Tell Overture* as a two-minute xylophone solo, for instance? Or a fantasia from "Verdi's *Bal Masque*" (*sic*!) for cornet solo? The crudity of the medium, with its elaborate recording horn and severe time limits on either the earliest wax cylinders or the early seven-inch discs, begat musical crudities that bring a smile of mingled nostalgia and disbelief today.

In those days (and I'm thinking of the era before World War I) there was no hope of recording a full symphony orchestra — let alone a full symphony. The musicians were at the mercy of the recording horn, that gaping maw to gobble sounds. The cutting stylus (somewhere near the epiglottis, perhaps) would respond only to sound pressure itself; distant sounds would cause the tiniest of tremors in the stylus and get lost in the rush of surface noise. If the performer was to be heard, he had to be close to the horn. A 100-piece orchestra could no more fit into the studio than it could into an elevator.

There were other problems, too. While the human voice might often reproduce with surprising verisimilitude on this equipment (though some voices were considerably more phonogenic than others, and, in the earliest years of the disc, the singer was sometimes chosen more for "vibrancy" of projection than for musicianship), some instruments proved almost impossible to record satisfactorily, at least in groups of any size. If you listen carefully to some of the early Pathe orchestrally accompanied discs (those of tenor Tito Schipa are a good example), you may be shocked to discover that the solo violin of familiar passages sounds, instead, like a cornet. Trust your ears; violin tone (unless the instrument were to replace the singer right in front of the horn) came out sounding too thin to make a juicy solo very appealing.

As a matter of fact, a gentleman named Stroh eventually designed a violin specifically for the recording studio. Instead of the usual hollow body, whose acoustic properties had taken painful years to perfect, it had a much smaller one of solid wood. And attached to this "sounding board" was a small brass horn, angled to project all the sound toward the recording horn.

As far as I know, no self-respecting virtuoso ever used a Stroh violin for a solo recording, but the cumbersome makeshift did emit enough sound of sufficiently violin-like quality that something resembling a string section could be assembled in the studio. The lower woodwinds, too, seem to have posed problems; in fact, many of the lower instruments took on a honking quality unless they were supported by trombone. At the other end of the spectrum, flute and piccolo were lusterless, if recognizable.

The real shocker for modern music lovers, however, lies neither in the mayhem that was practiced on the masterpieces, nor the patchwork that passed for an orchestra — nor even in the sound itself. Above all, the element that establishes the (relative) antiquity of the acoustic era is the way in which these recordings were received at the time. The expressions of approval that were lavished on them can be read almost verbatim in the current literature; the very phrase "high fidelity" appears to go back to Edison's day, as do live vs. disc demonstrations in which the auditors claim they can discern no difference. What modern ears can barely tolerate, contemporary ears heard as perfection.

The ear — or, rather, the mind, controlling what portion of the available auditory stimuli reaches the consciousness — is a fantastic information-processing device. Once your sensibilities are tuned to a given audio medium, it's easy to overlook its imperfections. The collector learns to "hear through" the surface noise, little disturbed by it, just as the inveterate train traveler learns to admire the passing view through dirty windows. In theory, binocular vision helps us ignore visual information in one plane, while concentrating on another. But what the mechanics of hearing can't manage (the physiological tuning-out of selected acoustic information), the mind can. Once we learn the *relationship* between artificially reproduced music and live music, we also learn to reconstruct the latter from the former, ignoring that portion of the auditory experience that does not contribute to the reconstruction and supplying from memory at least some of what may be missing.

The real problem arises when our fund of memory is inadequate to a particular task. What, for example, did Caruso *really* sound like? Unless you're old enough and were able to hear him in person, you have no "image" (even dimly remembered) of the live voice. My mother heard him once. I've asked her what he was like, but each time she can find only one adjective that seems to cover the case: "loud." That's not much help. The accompaniments on the recordings supply many clues. If the piano sound is muffled, for example, so must the voice be. But there remain differences in vocal quality between one recording and another which can be explained neither by the difference in overall recorded quality nor by the aging of the singer. (Like many tenors, Caruso gained richness but lost flexibility in vocal quality with the years.)

To some extent, the quantity of Caruso's recordings helps us abstract the properties of his voice. With less prolific artists, we either accept what we hear as definitive or remain in doubt.

A famous example is Jean de Reszke — some say the greatest tenor who ever recorded. He was among the singers captured by Lionel S. Mapleson, the Metropolitan Opera librarian and sometime violist in its orchestra, on an Edison cylinder machine that he set up, it is said, in the prompter's box during stage performances. Without the benefit of proximity to the recording horn, the voices were captured poorly. De Reszke also appears to have made cylinders for the redoubtable Signor Bettini, an accomplished diletante who invented (among many things) some improvements for Edison's equipment. Bettini used his gear to record the many stars to whom he had access through his wife Bessie Abott, a vaudevillian-turned-opera star. His final recordings were made for Pathe in France but, apparently due to inferior quality, were never issued.

All trace of the Pathes beyond the tantalizing fact of their announcement has disappeared. So have the Bettini cylinders, which — assuming they existed and had not already been broken — may have been destroyed along with Bettini's Paris warehouse during World War I. That leaves us with Mapleson's dim fragments. Surely, even the most sensitive of modern ears can only guess at the glories that lie hidden on the cylinders behind the clatter of mechanical noises.

Another, quite different example is the improbably named Nunu Sanchioni, an Italian operatic soprano of the early electrical recording era (the late '20s and very early '30s). Even by 1930, when she made some records with the baritone, Apollo Granforte, the electrical cutters

Continued on page 22

STUDIO MONITOR PRECISION...
LIVING ROOM BEAUTY

MONITOR-C FROM BOZAK

For more than a decade Bozak has been supplying monitor speakers for the most critical professional audio applications — recording studio control rooms, backstage at theaters and concert halls, broadcast studios — applications where the most precise reproduction of original performances is vital for commercial success.

Now Bozak has developed a speaker for use in home music systems that combines the accurate aural reproduction of its studio monitor systems with the visual appeal of the fine furniture enclosures for which Bozak's own cabinet shop is justly famous.

Monitor-C is unique in its speaker complement — 12 in all, including four wide-range speakers for the bass and mid-range regions and eight tweeters for treble notes. All speaker diaphragms are of neoprene-coated aluminum and, thus, are non-hygroscopic, so that changes in atmospheric humidity do not result in changes in performance.

You have probably never heard a speaker system with such a combination of transient-response capability, smooth over-all response in the entire 30-to-20,000-hertz range and broad spatial coverage as the Monitor-C. These listener benefits are particularly realized when the Monitor-C is used with the uncompromising new Bozak Model 929 amplifier.

Monitor-C can be heard at selected Bozak dealers. We'll gladly send you their names.

Bozak®

BOZAK, Inc., Box 1166, Darien, Connecticut 06820

Available at

Brands Mart
Boston
(admittance by student ID or Brands Mart Courtesy Card)

K & L
Watertown

Tweeter, Etc.
Harvard Sq.
Chestnut Hill
Brockton
Brookline

Soundscope
Boston
Brookline
Hadley
Manchester, N.H.

HiFi House
Worcester

Sound Track Audio
Woonsocket, R.I.

Sound Sales
Fitchburg

Malco Electronics
Lawrence

Resistortronics
Burlington

In tune with the times.

For years Sherwood's Model S7100A stereo receiver has been considered the most popular unit in its class. For good reason.

And now the S7100A's successor—our new S7110—seems destined to carry on the tradition. For equally compelling reasons.

Among them:

Minimum RMS power output @ 0.9% total harmonic distortion (both channels driven): 17 watts per channel @ 8 ohms, 40-20,000 Hz.

Direct-coupled amplifier (Yields power bandwidth of 9-50 KHz.).

Hermetically-sealed micro-circuits, FET circuitry.

2.0 μV FM Sensitivity.

Solid-State Ceramic FM IF filters.

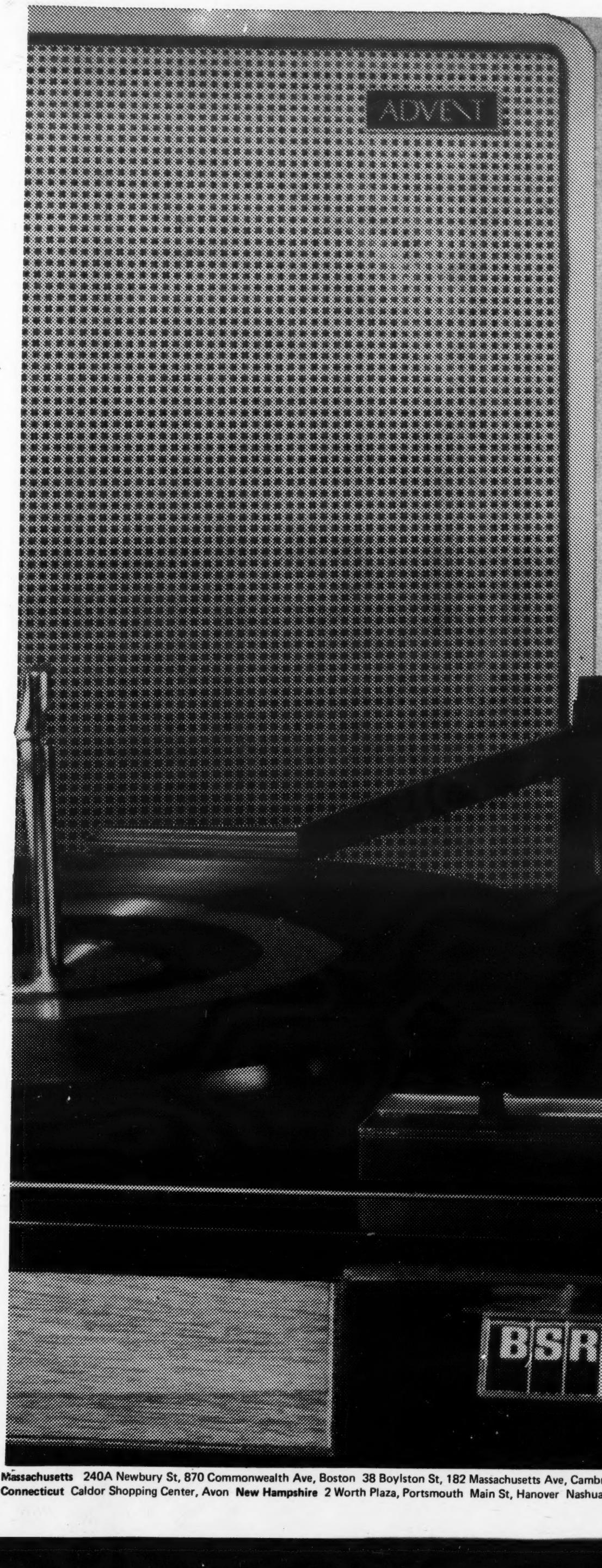
And, like all Sherwood products, the S7110 has been designed for maximum enjoyment with minimal potential for malfunction. Because, in addition to utilizing only the finest of proved componentry, our engineering effort has always been directed toward the goal of design simplicity.

Careful design, the highest quality components and workmanship: they're not credentials you commonly hear these days. Particularly in a receiver that lists for under $240.

But just listen to the difference they make.

Sherwood Electronic Laboratories
4300 N. California Ave.
Chicago, Illinois 60618

Sherwood
The word is getting around.



You'll
system
busi

Stereo stores differ.

Some sell you stereo at a little under list price.

Tech Hifi sells so low we can guarantee you the lowest price. We'll put that promis in writing on your sales slip.

Tech Hifi has a large professional service center right here in Boston. You'll never have to ship your stereo off to a distant manufacturer for repairs.

All stereo stores *hope* you'll be happy wi your purchase.

But Tech Hifi *guarantees* your happiness. You can return anything, if you are dissatis-

tec

Quality Compo

One of the things you'll like
Of The Week. Like the one you
Advent/2 Loudspeakers, and a B

Massachusetts 240A Newbury St, 870 Commonwealth Ave, Boston 38 Boylston St, 182 Massachusetts Ave, Cambridge, Route 9, Framingham, Route 1 Dedham, 352 Main St, Stoneham
Connecticut Caldor Shopping Center, Avon **New Hampshire** 2 Worth Plaza, Portsmouth Main St, Hanover Nashua Mall Extension, Nashua **Vermont** 150 Church St, Burlington, 21 Main

like our
n of doing
siness.

ist
e
nise
ce
with
ess.
tis-

fied for any reason, within seven days, and get all your money back.

And you can trade in your equipment within three months, to get full credit toward the list price of new components.

Many stereo stores can sell you a decent music system.

But at Tech Hifi you get a decent system of doing business.

Which is why 100,00 people have decided to do business here.

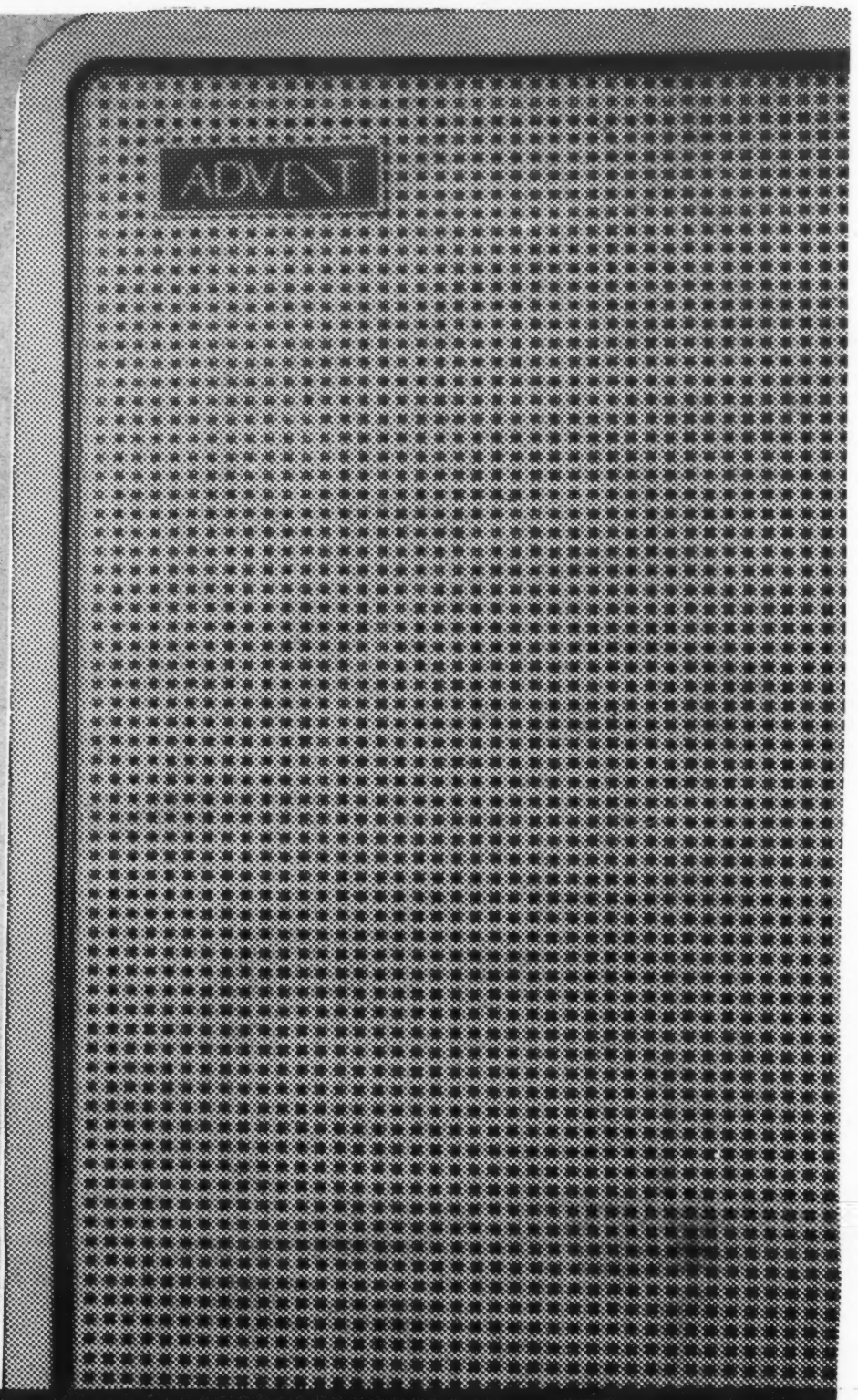
Come, hear.

ch hifi

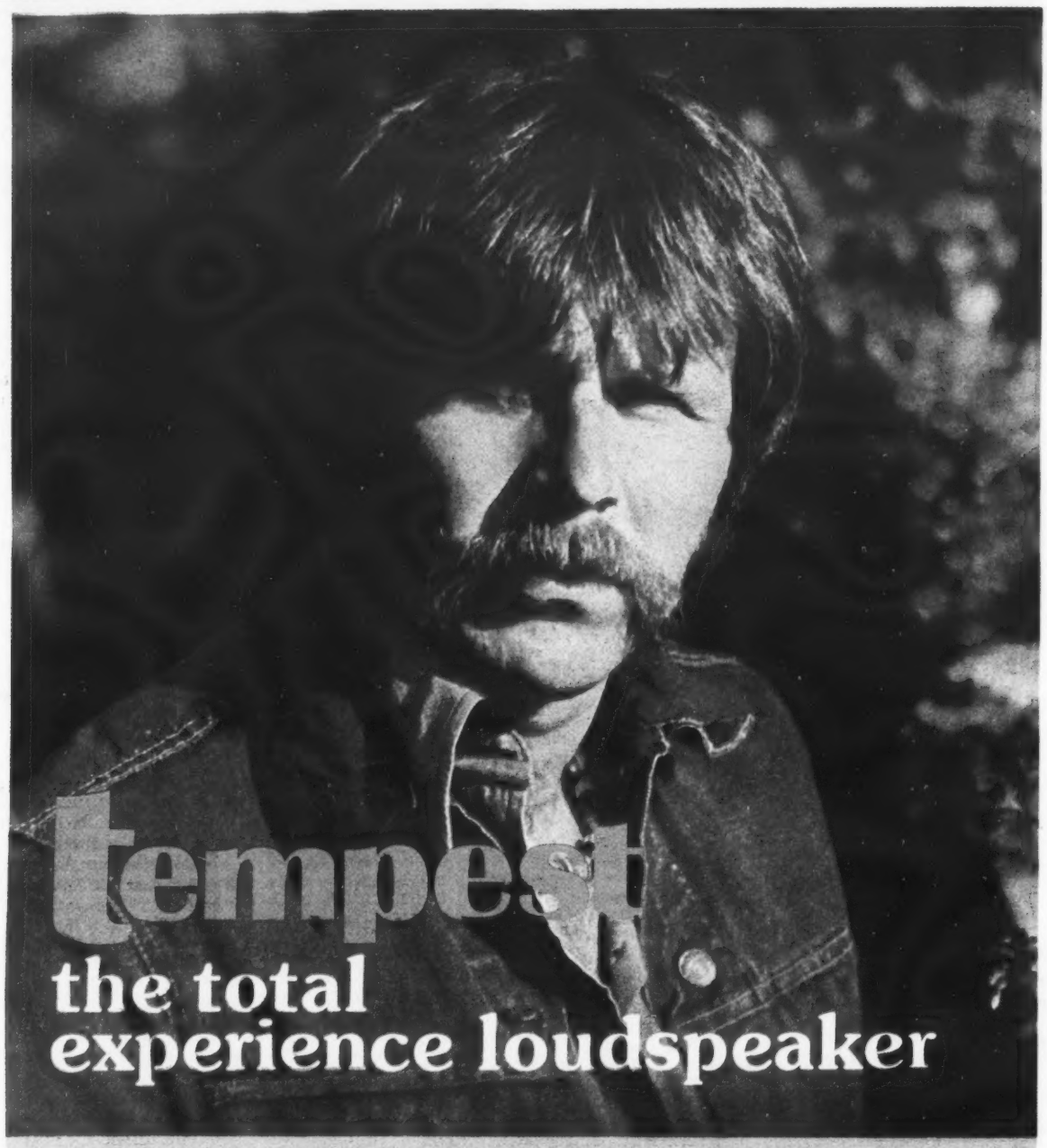
mponents at the Right Price

like about doing business with us is our Special System you see here. It features the Nikko 1010 stereo receiver, a BSR 2260X Automatic Turntable. THIS WEEK:

$299



neham 667 Main st, Waltham 279 Main St, Worcester 48 Teed Drive, Randolph 186 Main St, Northampton, 253 Triangle St, Amherst **Maine** 342 Fore St, Portland
Main St, North Bennington **Rhode Island** 165 Angell St, Providence 1989 Post Rd, Route 1 Warwick



Introducing the first super high efficiency Heil air-motion transformer loudspeaker

Finally a discovery in high fidelity—the total musical experience. No longer let yourself be sold a conventional loudspeaker. Let your ear, your experience sell you on a trio of new loudspeakers, the *Tempest Lab Series* by ESS, so extraordinarily efficient they use only one-half the energy of any other bookshelf speaker (and one-tenth the power of most). So convincing in their thunderous bass attacks, they evoke an explosive musical response. So clean and lightning-like in the high frequency out-put and dispersion of the Heil air-motion transformer "power ring" tweeter, they fill the air with such clear excitement you're letting go, and enveloped in a total sonic experience.

The heavy, super high efficiency bass woofer and newly designed Heil air-motion transformer "power ring" tweeter used in the *Tempest Lab Series* give you the raw excitement of the live performance reproduced superbly at actual levels. Tune in on intensity. Hear a moving new experience—music reproduced with stunning clarity and impact.

Break free of routine judgments. Skip over all the "me too" loudspeakers using conventional drivers, the "we use three speakers instead of two" speaker lines, the "we use two speakers instead of three" speaker lines. Try a new line. Tempest.

Listen carefully. Make your own comparison. You can trust yourself—and you know you can because you're hearing and **feeling** the difference. Then let yourself go. Go Tempest.

TEMPEST DIV., ESS, INC.,
7719 FAIR OAKS BLVD., CARMICHAEL, CA 95608

MASSACHUSETTS

- **Atlantis Sound**
  Framingham
  Cambridge
  (2) Boston
  Peabody
  Allston
  Worcester
  Braintree
- **Demambro HiFi**
  Boston
- **Linear Sound**
  Worcester
- **Seiden Sound**
  Amherst
  Pittsfield
- **Tweeter etc.**
  Chestnut Hill
  Cambridge
  Brookline
  Brockton
- **Waltham Camera**
  Waltham
- **Fred Locke Stereo**
  Springfield

CONNECTICUT

- **Fred Locke Stereo**
  New Haven
  E. Hartford
  Avon
- **Atlantis Sound**
  New Haven
- **Audiocom**
  Old Greenwich

NEW HAMPSHIRE

- **Action Audio**
  Concord
  Manchester

RHODE ISLAND

- **Hale Electronics**
  Lafayette Radio Associate Store
  Westerly, R.I.
- **Atlantis Sound**
  Providence

VERMONT

- **IES, INC.**
  Essex Junction
  Burlington
- **Stereo Theater**
  Rutland

Eras

Continued from page 18

used in Milan were not very advanced and were, in fact, inferior in some respects to acoustic apparatus at its best.

Specifically, these cutters had a nasty tendency to peak in their upper range, emphasizing the overtones in high voices and making them harsh and penetrating. I once described Sanchioni's voice on these discs as sounding like a buzz saw in full cry, and I can't think of any better description now. And because of the cutter's peak, her high note at the end of one side is so horrendously over-recorded that it is clearly visible at 10 paces.

I bought the record many years ago (for the sake of Granforte's performance, naturally) and always wondered that the Gramophone Company should have partnered so fine a baritone with this banshee. But a few years ago, when Advent first offered its multi-band equalizer unit, I tried using it to undo the cutter resonance. Revelation! But of course, I still can't tell for sure whether what I heard sounded like Sanchioni — the *real* Sanchioni.

Those who bought the record in 1930 had less reason for such qualms. Their phonographs were less capable of reproducing the high-frequency peak than my modern equipment is. Indeed, the peak probably let them hear sounds that never had been available to them before. And experience had taught them how to listen to records: how to synthesize the natural sound from what they heard. Their psycho-auditory apparatus was uncluttered by considerations of stereo (or quad!), of harmonic distortion percentages, of all the "technicalia" by means of which we've been able to diagnose and correct sonic ills.

Somewhere, I remember reading that a visitor to the African bush (was it C.G. Jung, perhaps?) once presented a group of residents with photographs of themselves. The Africans, who, in that time and place, were innocent of anything we term civilization, puzzled over the prints. They examined both sides of the paper and turned the images around, seeking some significance. Eventually, they recognized in them representations of each other's faces, but it was the visitor's unavoidable conclusion that the Africans had to *learn* to see photographs.

We learn to hear recordings in much the same way. But, having learned, we find ourselves to be the end recipients of a communications chain with a huge redundancy factor — that is, a modern recording played on modern equipment reproduces many times the quantity of detail needed for us to perceive even relatively subtle musical meanings. If we then remove some of that information — say, by cutting off the top two octaves of frequency response — our first sensation will be deprivation. But if we continue to listen this way, and only this way, we eventually will come to infer the missing detail from the available sound. And before those top two octaves could be reproduced, listeners learned to make the inference as part of the basic ability to hear music when, in fact, they were listening only to the sound of a steel or cactus spike being dragged along a furrow in a shellac pancake.

There are those who feel that this route — via equipment contemporary with the recording — is the only authentic one for the enjoyment of antique recordings. Well, that, too, is partly a question of learning how to listen. I'm of the opposite school.

Continued on page 36

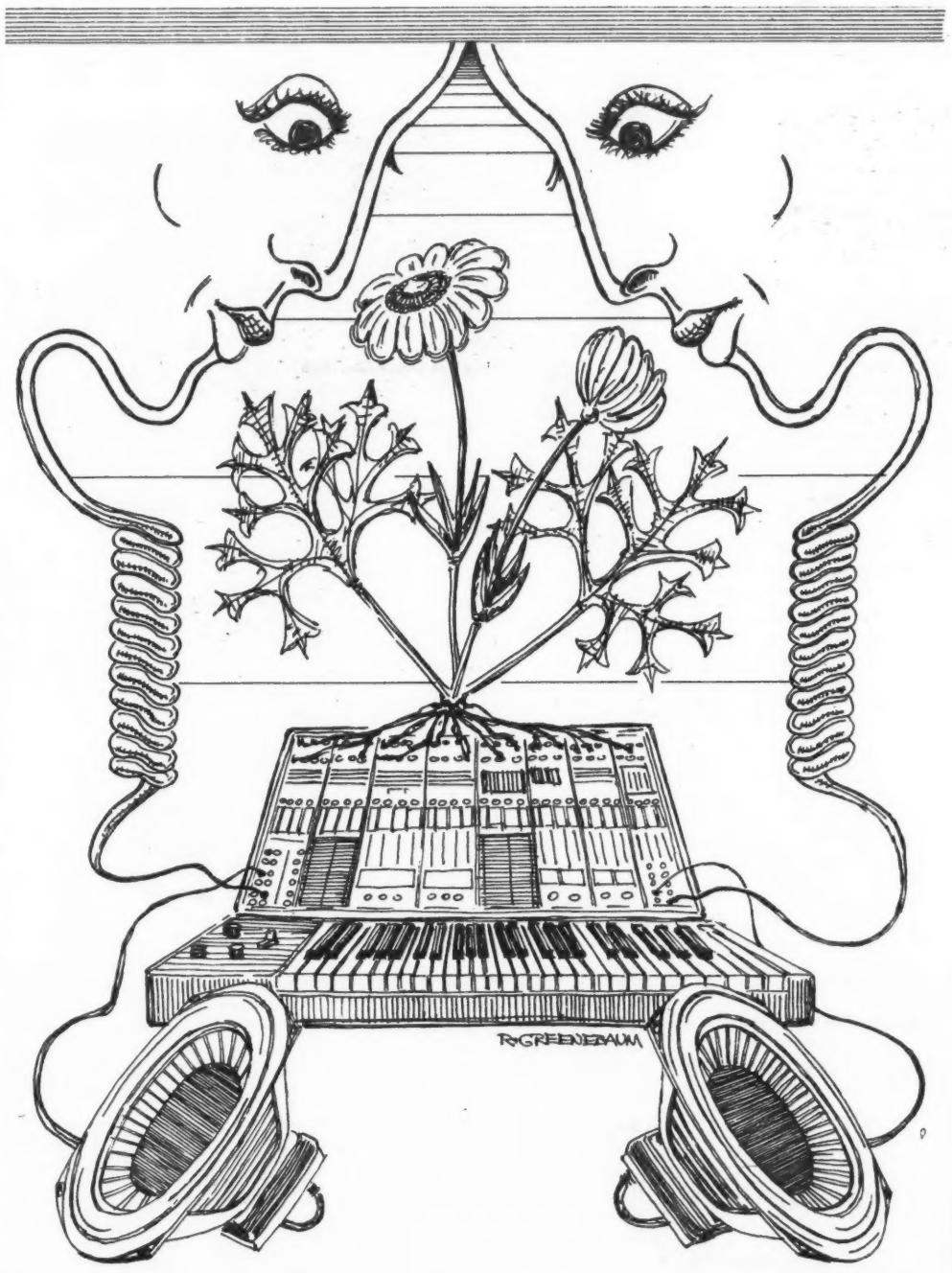
They've Got the Whole World in Their ARP

Synthesizing the Big Sell

By Peter Birge

I just came back from a long tour, so I messed with my ARP 2500 at my place. It's not like playing a sax late at night, where you're always struggling, working to improve your technique or your tone. You can sit around with the ARP and let the instrument work for you; it does things. Everyone should have a three-hundred-dollar synthesizer they can go home to. So they can be themselves on a freak box and find a sound so weird, that just possibly it has never been heard before. I've seen some very straight, stiff-assed people start playing around with my ARP, begin getting freaky noises and love it. God knows these people need to find their own real, off-the-wall selves and be comfortable freaking out to freaky noises late at night. The instrument is infinite.

—Mike Mandel, keyboard artist with Larry Coryell and the Eleventh House



Robert Greenebaum

When you sneeze, you usually ask for a Kleenex. And when you're looking to synthesize electronically a little soul music, you'll say Moog — but the odds are strong you'll end up buying an ARP instead. With a yellow logo over the door, of a treble clef with a wall plug tail, ARP Instruments, Inc., located in Newton along an idyllic birch-lined stretch of the Charles River, is serving notice to visitors that it means to reinvent music as we know it and to dethrone Dr. Moog as the reigning institution whose name is synonymous with synthesizers.

Little more than a decade ago, Moog invented his quirky music-making machine and began peddling it to the more refined avant-garde schools around the country. And only five years back, when ARP came on the scene, just two companies were competing for a market that included roughly six popular artists recording tracks with freak boxes. Yet since 1970, their numbers have swelled to 6000, and more than 20 newly founded outfits compete for a share of their business. Even with the heat on, however, ARP still dominates the field to such a degree that within, say, 10 years, their synthesizers will have saturated our musical generation so thoroughly that nobody will be surprised to see an ARP hanging in the window of his or her neighborhood pawnshop along with the battered Fenders and tarnished saxophones.

If you doubt this prediction, you have only to turn on your stereo or your Friday night rock concert; you'll quickly see how ARP has been edging up on your consciousness. Hear that nice bass line on Stevie Wonder's "Reggae Woman"? An ARP 2600. How can he read all those gizmos on the control panel? Well, ARP fixed him up with a special model featuring a portable keyboard hung around his neck and a hundred wires snaking back to his ARP console, which is emitting some hallucinogenic fog. Then there's Elton John, Donovan, Billy Preston. The list goes on and on. Perhaps the best evidence that ARP has arrived on the scene lies in the fact that, of late, stars like Pete Townshend of the Who have taken to kicking ARPs around the stage — a tell-tale sign that a rock musician has achieved full rapport with his "axe." And while ARP is relying heavily on artists to work its way into our reality, its aggressive sales force and in-house advertising team keep our ears full of those quavering signals and our eyes bleary with esoteric copy, while the electronic music labs at schools like BU are booked solid 24 hours a day, 24 hours in advance.

Roger Dumas, PR director at the ARP factory/office in Newton, is the crux of the company's success. Through the '60s, he wandered around America, touring the various synthesizer companies. After a short flirtation with Moog, he arrived at ARP, where he masterminds their unique public image. For example, he prints up a monthly bulletin, the *ARPeggio*, for his customers and dealers, which features everything from obits of deceased synthesists to an 'Ask ARP' column. He's also writing the company history, while keeping tabs on every imaginable fact known about ARPs. Dumas stays on top of things.

Sales, of course, is an all-important facet of his work. According to Dumas, ARPs are already in Bangladesh, in Guam, even in Somalia. "I just can't figure, though," says Dumas, who was once a rock drummer but now has that crystal-eyed, hygienic look of a computer programer, "just why we were able to sell 38 to Iran a while back."

Perhaps because Roger is a PR-pure intellect committed to handling fact flow, he uses the same approach to account for the surge in domestic ARP sales. "Life, like music, is moving at a faster pace every day. Musicians are beginning, I think, to realize that they must learn to swiftly use and discard information if they want to keep up with the information flow. That's what a synthesizer's all about."

To find out just what a synthesizer's about and how it's sold, one must first check out the ARP acoustically sealed demonstration booth littered with three-octave keyboards wired up to huge consoles with blinking lights. Monitoring one of these units, the 2600, is an oscilloscope that is blipping its white flashes across its green screen, though nobody is anywhere near it. Sensing my apprehension, Roger calmed me by explaining that, once switched on and properly tuned, an ARP such as this one is capable of playing itself — no virtuoso need meddle with the keyboard. Relying on memory

Continued on page 24

The Senior Vice-President: *"I used to go down to the Audio Engineering Society Show in New York and hang around (Moog's) exhibition booth and pester him a lot with questions. Finally, he got tired of it and told me to get lost. I think he's regretted that."* —David Friend

Jerry Berndt

The Salesman: *"We call it the primeval swamp test. I adjust the machines just so on their racks in the assembly room; then, every 10 minutes for two weeks I switch 'em on to hear crickets chirping and bullfrogs croaking . . ."* —Phil Dodds

Getting the Signals Straight: A Short Primer on Electronic Synthesis

By Jim Michmerhuizen

Sounds are produced by wiggling things.

Loudspeakers can wiggle fast enough to produce sounds.

Electronic signals can determine exactly what sounds a loudspeaker will produce, by supplying the pattern of its vibration. In order to have enough power to move the loudspeaker cone, these signals must have passed through a power amplifier.

A power amplifier does not change signal patterns — it only makes them more powerful.

The patterns themselves may come to the power amplifier from a synthesizer. Or from a microphone, or guitar pickup, or tape recorder or phono cartridge.

In any case, such signals (i.e. patterns of electrical change) always represent, either in their origin or destination or both, sound waves: the atmospheric ripples that we hear as sounds.

A single continuous tone, for example, is produced by a series of ripples; the beginning and ending of the sound is the beginning and ending of the ripples, and so on.

A synthesizer is a means of producing "sounds" by direct generation of the electrical signals required.

Electronic organs and electronic pianos also do this. But they are not *general* sound-producing instruments.

A synthesizer *is* a general sound-producing instrument. With proper instruction, training and experience, a musician can produce from a synthesizer very nearly any kind of sound he wants — not just keyboard melodies.

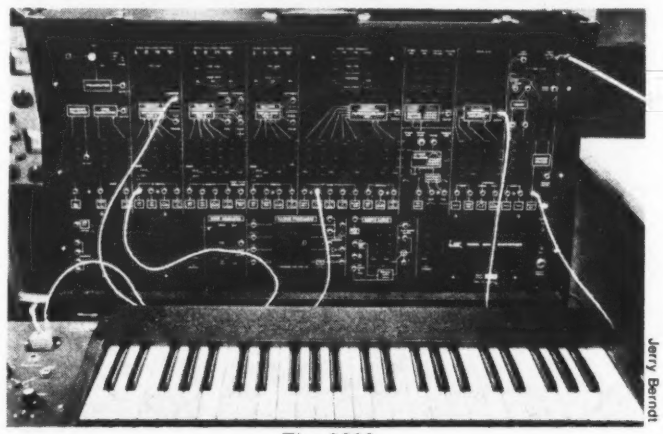
Any signal destined to actually reach a loudspeaker is called an *audio signal*. These usually originate from either a *noise generator* or from one or more *oscillators*. Oscillators are the source of either pitched tones or a click-series, depending on their output frequency and on the pattern of their oscillation. The pattern is called the *waveform* of the oscillator output signal; typical waveforms are sine, triangle, pulse and sawtooth. They are named for the way they look on graphs.

At audio frequencies (i.e. frequencies that, in fact, produce pitches and not clicks in our ears), each waveform has a characteristic tone, or *timbre*. *Sine* and *triangle* wave are relatively smooth and dull. *Sawtooth* and *pulse* waves produce bright and buzzy tones that are quite irritating in their raw state; they have more overtones than most sounds, particularly those of conventional acoustic instruments.

Filtering is probably the most important means in a synthesizer of "working over" the raw oscillator signals. A filter alters the timbre of oscillator tones by directly altering the waveform of signals passing through it — smoothing them out a little, or making them look a little "springy" (on graphs or visual displays such as an oscilloscope). A *low-pass* filter, for example, can remove the buzzy upper harmonics from a raw sawtooth or pulse wave or the higher-frequency "hiss" components from a noise signal. A *high-pass* filter, on the other hand, removes lower harmonics and can make a sawtooth sound very bright and "stringy" (like a violin).

The *oscillators, filters,* and *amplifiers* in a synthesizer are usually designed to be controlled not only by manual adjustment but also by voltage levels at special *control inputs*. (Thus, the abbreviations "VCO," "VCF," and "VCA," respectively.)

Without voltage control of the basic functions of a synthesizer, it would not be possible to perform anything interesting at all. Oscillators, for example, produce their tones continuously from the moment the synthesizer is turned on to the moment it is turned off. Ordinarily, however, a performer doesn't want continuous tones — he wants discrete note-"events" when he presses a key. Such practical problems are easily solved with a voltage-controlled amplifier and an *envelope generator*. The procedure is simply to turn the VCA volume all the way *down* so no sound gets through, and then to use a voltage output from the envelope generator to "open up" the VCA whenever necessary. The envelope generator, in turn, produces its voltage output only when a key is depressed. Manual settings on the envelope generator itself can determine the relative speed with which its output voltage rises and falls, and thus can make the difference between producing short percussive events or long smooth ones like the bowing of a violin string.



Jerry Berndt

The 2600

By similar means, one can set up far more complicated control connections in which the voltage outputs of some devices in the synthesizer are used to determine the operating characteristics of other devices directly involved in the production and modification of the audio signals themselves. VCOs can be controlled with respect to their output frequency (i.e. "pitch"), VCFs with respect to their cutoff frequency (i.e. the relative brightness or dullness of their effect on sounds) and VCAs with respect to their gain (i.e. output volume).

Some devices in a synthesizer exist only for the sake of producing *control signals* (as opposed to audio signals); one example of such a device would be the envelope generators already described. Another is the keyboard itself, which does not in any sense produce sounds, but only the voltages necessary to control the pitch of an oscillator and the "firing" of an envelope generator (usually called "triggering" or "gating" of the generator).

Other control sources in larger synthesizers may include *sampling* circuits and *sequencers*. Both of these are usually used as alternatives to the keyboard in the production of long strings of notes, but the direct output from these, like that of the keyboard, is not itself an audio signal — it never reaches the loudspeaker — but only a series of voltage levels and triggers with which one controls VCOs and envelope generators. The most bizarre, non-tonal sounds come from setting up interactive control signal connections such as AM and FM patches, *ring modulation* and even feedback loops among two or three oscillators. These can be fascinating to look at on an oscilloscope, while one is listening to the same signal over a loudspeaker. The neat and precise VCO output waveforms can be altered and transformed beyond recognition either by eye or ear; signals can be mixed, added, multiplied together to produce new timbres and waveshapes. And the results of several different transformations can themselves be subjected to further ones.

In sum, two basic ideas are involved in all electronic music synthesizers. The first is that acoustical waveforms can be generated and modified purely by electronic means. The second is that wave-generating and wave-modifying equipment may be controlled electronically.

You may think of this as a kind of "remote control," in which one piece of equipment may control the frequency or gain of another piece by an electrical signal. Other instruments such as electronic organs, electronic pianos, theremins, and so on, generate and/or modify their sounds electronically, just as synthesizers do. But other instruments are designed only for manual control through keys, pedals, stop tabs or knobs.

The oscillators, filters and amplifiers in a synthesizer, however, are designed to be controlled both manually and by voltages. A vibrato effect, for example, may be obtained by manually varying the frequency of an oscillator rapidly over a small range, but a much smoother and more flexible vibrato is created by using a low-frequency sine wave to control the pitch of the oscillator output.

SAMETRON SAMETRON SAMETRON SAMETRON SAMETRON

SAMETRON CAN MAKE YOUR
OLD STUFF SOUND
LIKE NEW. . .

NORDMENDE · Blaupunkt · TELEFUNKEN · SUPERSCOPE · Panasonic · GRUNDIG · Garrard · SONY · Norelco · ELAC · PIONEER · PE · Akai · Sansui · TANDBERG · PHILIPS · UHER

AND YOUR NEW BETTER THAN NEW. .

THAT'S BECAUSE OUR PROFESSIONAL TECHNICIANS USE ONLY GENUINE REPLACEMENT PARTS. SO THE NEXT TIME YOU WANT TO HEAR SOMETHING NEW FROM SOMETHING OLD GIVE US A CALL. . .

SAMETRON

401 HIGHLAND AVENUE SOMERVILLE, MA

625-8777 AT DAVIS SQUARE 623-9150

THE ONLY CENTRE PROPERLY EQUIPPED TO SERVICE THE FOREIGN AUDIO PRODUCTS

RADIOS•TAPE RECORDERS•STEREOPHONIC•TV
HIGH QUALITY SERVICE — LOW PRICES

SAMETRON SAMETRON SAMETRON SAMETRON SAMETRON

ARP

Continued from page 23

'chips' in its innards, he says, an ARP can perform a 90-note melodic sequence endlessly without a touch. Ah, so it's a data bank? "Not at all," Dumas strongly objects. "We're not selling computers here. These are only analog machines, whereby raw information such as voltages are processed into a binary object code." But while Roger touts his product line in IBMese, I am wondering why the unit is all a-twinkle without my hearing a sound. "Oh, it's on," he reassures me. "But right now it's playing in a frequency above the range of human hearing."

How's that again? Well, we humans hear sounds only between approximately 20 and 20,000 Hz, while an ARP can bellow anywhere from a low of two Hz to a high of 150,000 Hz. "Dogs can hear up to about 50,000," Roger says, raising the pitch on the 2600. "Now — any dog should be able to hear this [silence]; they wouldn't be able to hum along with it, but . . . well, I think most dogs in this neighborhood are smart enough to stay away from this place." Dolphins, interestingly, have an aural range that can listen easily to an ARP's top end. Here, too, Roger's got the pertinent facts on the tip of his tongue: ARPs are featured on the *Day of the Dolphin* soundtrack.

*

NEW YORK — *Bob Mason of the group Stardrive was the victim of a bizarre assault which occurred during the band's premiere performance at New York's Radio City Music Hall. Drive was halfway through their set when a fan obviously stoned out of his mind crawled up onto the stage and tackled both Mason and his handmade synthesizer . . . . The crazed fan, while being ushered into a squad car by police, confided to both Mason and manager Fred Heller that it was the synthesized music that spurred him on. "The music was in my soul," he said. "The Devil made me do it."*

—Zoo World, Dec. 5, 1974

A few more facts and a little thought should tell you that moving in next door to a fledgling ARPist isn't at all comparable to having a tone-deaf saxophonist down the hall. ARPs may well have preset voices that automatically produce soothing string ensembles. But imagine a violin trio skittering up and across your aural field before shrieking past your hearing with a touch from the portamento gliding mechanism on the console. By arithmetically doubling the frequencies for each eight-note key, one can estimate that an ARP has something approaching a 20-octave range, only 10 of which are audible. If Ella Fitzgerald can break a glass with her scatting on Memorex tape, what can an ARP do to your brain cells? (Don't let that three-octave keyboard fool you.) And should your neighbor start ARPing his vamps down around five Hz, just remember that the French police have recently perfected one of the most effective riot control devices using only a five-Hz signal with a synchronized strobe: when they switch it

Continued on page 26

Watts
for the life of your records

CARES FOR YOUR RECORDS

Watts Record Care Equipment safely and surely removes dirt, dust, static charge and retains the sparkling sound of new records. Get the best . . . Get WATTS Record Care Products.

NEW FORMULA
ANTI-STATIC FLUID
(FOR DUST BUG, PARASTAT AND PREENER)

LIST $3.00

SALE PRICE $2.50

TURNTABLE DUST BUG LIST $7.95
SALE PRICE $6.75

DISC PREENER LIST $4.95 SALE PRICE $2.50

the Coop
HARVARD SQUARE

MIT STUDENT CENTER

CHILDREN'S HOSPITAL MEDICAL CENTER

LOAD UP WITH BLANKS

the music tape™ BY CAPITOL

Cassettes	*Sale Price*
C-60 3-pack	$3.99
C-90 3-pack	$5.99

8-track Cartridges	*Sale Price*
45 min. 3-pack	$3.99
100 min. 3-pack	$5.99

EMI
TM OF EMI LIMITED

Capitol®
REG TM OF CRI

BUY TWO CASSETTES OR CARTRIDGES GET ONE FREE!

Here's sure-fire savings on the music tape BY CAPITOL. Buy three premium blank cassettes (60 and 90 min.) or cartridges (45 and 100 min.) for the price of two. there's no limit per customer while supply lasts.

Cassettes and cartridges are extra high output/low noise formulation. Jamproof, too.

If you record music, quit horsing around with ordinary tapes. Load up with the music tape BY CAPITOL now, when it won't shoot your budget.

JORDAN MARSH

450 Washington St.
Boston, Mass.

PHONE ORDERS ACCEPTED—CALL 426-9000

ARP

Jerry Berndt

Birge-oning Genius: The author as ARPit player

Continued from page 24

on, the earthquake-like frequency irresistibly loosens the sphincters of anyone in the immediate vicinity. "When a rioter wets his pants," says Roger, "he usually doesn't want to riot anymore."

According to Dumas, the typical ARP purchaser is, as you'd guess, a rock musician between 18 and 25 who's interested in keyboards and electronic music. But that says nothing about the machine's capabilities for sheer noise. In the ARP educator's brochure, only one more of Roger's countless fact packages, high school teachers are warned to get with it because "you just lost your excuse for not teaching electronic music." But the hardsell is reserved for the English Department, where an ARP becomes indispensible for reproducing thunder or howling storms to accompany dramatic readings.

No, what we are talking about is power. Raw noise power, boosted by Con Edison at 110 volts at a rate, it is said, of about a penny and a half a working day, and in Roger's demonstraters, fed through a six-foot-high bank of Bose 1800 Series amplifiers to twin stereo stacks of Bose 800 speakers at opposite ends of the room. An ARP can make music, of course, but it also can make more than five million different loud screeches.

*

What is the nature of the sound itself? How is it produced and controlled? The key ingredients are oscillators and filters. The rate of oscillation determines the pitch, while the filters determine the tone color, from 'wah-wah' to infinity. Now, the wider open the filters are set, the more overtones are added onto a tone. Theoretically, it's possible to add up to 17 overtones onto a basic voltage signal. What we are building on is a pure sine wave — a wave pattern produced when an oscillator is moving *smoothly* back and forth. This signal can in turn be modified further by the "envelope generator" controls, which monitor loudness, attack, decay, and sustaining cycles.

The ARP 2500 is downright frightening: it can be programed to play a melody to your rhythmic accompaniment on the keyboard, and vice versa. By employing its 'Sequencer' circuit, it can be set to launch into countless riffs as soon as a certain note is struck on the keyboard. Furthermore, it is a modular unit, capable of being infinitely expanded. Dumas boasts that the thing can be rigged to play any sequence of any desired length. Your only limitation would be your pocketbook. Synthesizers are notoriously expensive, and the 2500 is no exception. Brand-new, with 15 modules to start from, will cost you $10,000.

But unless you were A+ in high school physics, you'll find programing this beast a real problem. First, you must "patch" one circuit into another, which is done by plugging short patch cords into your chosen oscillators and filters. It's a heady prospect: the combinations are innumerable, and use no ordinary musical terminology. "You know an ARP just sits there waiting for you to do the right thing," Dumas says. According to his ARP manual, here are but a few of the right things the unit could be waiting for you to do: Cookin' Conga, Heavy Metal Fuzz Lead, Firetruck with Siren, and a 727 Starting Up, Taxiing and Taking Off. For more experienced masters, there is Ethereal Phase Shifting on External Source or UltraGlide with Release Memory. In E-Flat?

*

As a constant in music I don't like a lot of gimmickry. I still haven't gotten over the 'wah-wah' peddle or that outer space organ. What's it called? A synthesizer? I'm not into that at all. I've heard a few things that sound like music but most of it's noise to me.

—John Fogarty, of Credence Clearwater

But say you wanted to swing with a hurricane whoosh at 50 knots to the measure. Just how you'd stumble across that particular sound, nobody can be sure. All noise is built from discrete sound waves. To offer an analogy, Roger explained that, once one had mastered the electronics of the machines and had a good grasp of the countless variables, he or she could proceed by way of the "tinker toy" approach to imitate anything heard. "If there's a sparrow out on your window ledge you can break down his song, by study,

Continued on page 28

DON'T BE DOLLAR WISE and SOUND FOOLISH

Custom engineered sound systems for musicians and clubs
SALES — RENTALS — SERVICE

SHURE — BOGEN — ELECTRO VOICE — AKG — VEGA — TURNER — ATLAS — UTAH SOUND PRODUCTS

Guaranteed Service Is Our Pride

FREE FREE FREE FREE FREE

Get a 7-inch reel of Audio Tape with every tape recorder overhaul

Good Until April 15, 1975

Sid Stone RADIO LABORATORIES inc. Electronic and Sound Engineers

901 Huntington Avenue, Boston
near Brookline Village

427-5323

The Mainstay of Sound in N.E. Since 1932.

minuteman The Audiophile Store

REVOX

A700
$1800.00

A77
$959.00

The REVOX A77 is an open-reel tape recorder designed to fill the needs of the serious audiophile and the professional industry. It is a maximum performance machine that offers everything we believe to be of value for use in the living room and for on-location recording. Most important, it provides maximum uninterrupted recording time with convenience and ease of use, and maximum electronic and mechanical performance.

QUALITY
NAKAMICHI 500
Dual-Tracer 2-Head Cassette System

This new DUAL-TRACER is in the finest Nakamichi tradition with entirely new and unique features that reflect the genius apparent in its famous predecessors, the Nakamichi TRI-TRACER decks. Focused-Gap Head . . . super-durable crystal permalloy core . . . professional full-range 45dB peak level meter.

NAKAMICHI $399

Mon.-Fri. 9 a.m.9 p.m. Sat. 9 a.m.6 p.m.

NAKAMICHI classic cassette decks—they're born, not made!

NAKAMICHI $499

NAKAMICHI 550
Battery operated/AC portable with specifications of a stereo deck. The premier portable cassette recorder.

CAMBRIDGE • 30 Boylston St. 864-8727 minuteman LAWRENCE • Essex St. 687-0777

Radio Shack®

INFLATION-BUSTING BARGAINS FOR COST-CONSCIOUS AUDIOPHILES!

SAVE $210

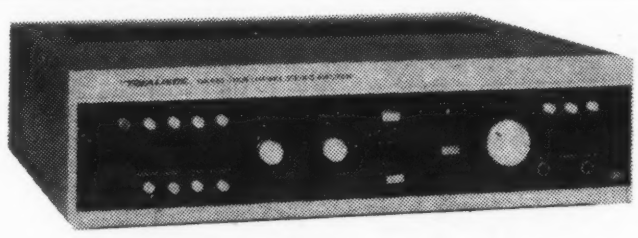
Reg. 459.95

IT'S A "STEAL"! REALISTIC® AM-FM STEREO RECEIVER WITH AUTOMATIC FM TUNING

Pocket 45% savings on our fabulous STA-220! Automatic FM tuning system, three tone controls. High/low filters, FM muting. Switching for 3 speaker pairs, Glide-Path® combined volume/balance controls. Auxiliary inputs, tape monitor. And more! There's only one place you can find it. . . Radio Shack.

249.95

31-2051



SAVE $100

BARGAIN PRICE! GET MUSIC VARIETY WITH STEREO & 4-CHANNEL AMPLIFIER

Marvel at true 4-channel sound plus enhanced 4-channel from all stereo sources! Tape inputs/outputs with monitor. $24.95 value genuine walnut wood case.

Reg. 199.95

99.95

31-4006

SAVE $45

AUTOMATIC MIRACORD 45 TURNTABLE

One of our finest! Gentle pushbutton operation and tracking under one-half gram. $33.95 value super-track elliptical stylus cartridge included. Walnut base.

reg. 164.95

119.95

42-2592

SAVE $47

STEREO HEADPHONES... FOR THE ULTIMATE IN REALISM

Electrostat energizer makes this headset unique. A great buy for the serious listener!

Reg. 79.95

32.95

33-1017

SAVE $50

AUTOMATIC MIRACORD 40C TURNTABLE AT LOW, LOW PRICE!

Top value! Massive die-cast turntable platter, adjustable anti-skate. $22.95 value elliptical stylus cartridge.

Reg. 139.95

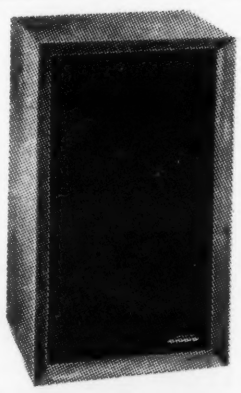
89.95

42-2601

Just Say "Charge It"

WE ACCEPT

BANKAMERICARD master charge



SAVE $30.05

FLOOR-BOOKSHELF ACOUSTIC SUSPENSION SPEAKER SYSTEM

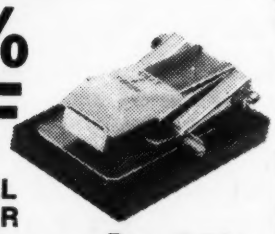
Reg. 70.00

39.95

40-451

Versatile Solo-3B sounds rich and spacious! 8" acoustic suspension woofer and Optimus-series tweeter. Handsome walnut veneer enclosure. 22½x12¾x9¼".

50% OFF



REEL-TO-REEL TAPE SPLICER

Reg. 3.99

Precision cuts and trims diagonally. Dispenser, roll of tape.

1.99

44-770

ARP

Continued from page 26

into its components — pitch, timbre, duration, melody, etc. Then, one by one, you tackle these until you've built up enough pieces." Having done this, he says, you then transcribe onto a 'facsimile sheet' just what was plugged into what and where the gauges were set in the event you would like to reproduce that birdcall in the future. "Don't be afraid to play around," Roger said, offering the feather-weight keyboard of a 2600. "You can't blow the thing up or burn its curcuits. It's made to withstand any experiment and no patch configuration is forbidden."

To initiate myself, I throw switches, flip levers, and plug in as many patch cords as seems consistent with good taste. Then I hit the main switch and tickle the plastic ivories with what I thought was to be my rendition of "Mood Indigo." Instead, I'm hearing "Mood Indigo" played not by me but by some asthmatic bagpiper lurking deep within the wiring circuits of the ARP. And rather than a sharp attack response, with every note struck comes a grudging wheeze, although one perfectly in key. Roger outlined in electronic terms what I'd just accomplished: "Well, not too bad at all for a starter. You've been using two different wave forms of the same oscillator. You've shorted out oscillator one with oscillator two and caused a feed backup loop between them while patching oscillator three back into itself." Making a few subtle changes, I replace my ailing Scotsman with what sounds like Bela Lugosi playing honky-tonk on his castle organ, replete with sounds of a dripping sump. "Very interesting," Dumas says, looking over my patchwork to see if he can improve on my technique. "Are we missing anything?" he asks solicitously.

Yes: Phil Dodds, head of ARP sales and repair. Without Phil, ARP would be minus its most incredible demonstration of all. Facsimile sheets aside, only Phil Dodds, of all of ARP's 150 employees, really knows how to make an ARP talk. He's got an inspired way of fiddling with the controls that supersedes mere patching science. And it's guaranteed that, within 20 minutes, Dodds can come up with that quintessential rock 'n' roll phrase: "Oh, yeah." There's no telling how many times he's performed this feat for visitors, but it must take him away often from his primary chores: quality control and the national organization of repair centers. On his wall is a map festooned with those little corporate flags, marking franchises opened after new owners successfully concluded Dodds's mandatory four-day seminar in ARP circuitry design and maintenance. Dodds claims that Moog by comparison has now only 12 national service centers around the USA, while ARP is preparing by spring to open another 20 in the deep South alone. "And they don't have our kind of quality control either," he boasts. "I call it the primeval swamp test. I adjust the machines just so on their racks in the assembly room; then, every 10 minutes for two weeks I switch 'em on to hear crickets chirping and bull-frogs croaking and other bog sounds. If everything's still going strong in 14 days, we put 'em in their boxes, shoot the whole crate full of expanding foam and ship 'em out to the dealers."

ARP 2600 performing with Edgar Winter

Dodds, meanwhile, has just about zeroed in on "Oh, yeah" on an ARP Explorer. When he hits the ignition button, assorted gleeks, grunts, and groans replace more mechanical splats and sproings — the ARP is slowly coming to life. Suddenly, Dodds hits a bull's-eye and I hear those two little words used by every rock star since Bill Haley and the Comets. To vary the effect, Dodds triggers the "sample and hold" button, which sends random voltages through the circuits, and the voices degenerate into a duet of hiddccupping yokels 'oh-yeahing' over a five-octave range. By patching in a little reverb, we arrive at an echoing tattoo of glunking subglottal tones decaying into outright babbling. *Oop Yoop. Bloop bloop.*

Only 15 feet away, Dave Friend, a founding force of ARP, imperviously continues his telephone conference with jazz musician Les McCann who has called from Hollywood to complain that he's having trouble with his patching. "Les isn't too far into the electronics of the thing yet," Friend says, cupping the receiver with his hand. "I find that my ears have really been turned into synthesizers over the years. Electronic sounds used to be so alienating that one thought that they would never get into the musical mainstream. But now, I find it impossible to perceive any strangeness in the sound whatsoever. The only problem was arriving at the right wavelength."

*

Doctor Moog and his machines were the only synthesizers around when Friend began tuning in 15 years ago. After having graduated from Yale with a double degree in music and engineering, he went to work for RCA in Princeton. Shortly thereafter, Allan R. Pearlman, an industrial electronics entrepreneur, got wind of Friend's work at the Yale Electronic Music School and tracked him down through the *Yale Alumni Magazine*. "Pearlman, his lawyer and I scratched our heads, and in '69 we opened up out here." And Allan R. Pearlman *et al.* went alphabetical, and ARP outsold Moog in its first year of operation.

"Moog had been in business for about five years when I was graduating from high school. And I'd go down to the Audio Engineering Society Show in NYC and hang around his exhibition booth, you know, and pester him a lot with questions. Finally, he got tired of it and told me to get lost. I think he's regretted doing that ever since."

That's likely, since in five years ARP's corporate earnings have climbed steadily, to a '73 figure of just a shade over two-and-a-half million dollars, an 85 percent profit increase over the previous year. In the beginning, Friend recalls, ARP pitted its biggest units, like the 2500, against Moog's and walloped him in the marketplace. Dr. Moog himself told me in a phone interview that his profits for '73 were a measly $400,000.

How ARP so quickly came to dominate the synthesizer field is a puzzle. Moog, while unwilling to concede that he's no longer the biggest, nevertheless sees ARP spreading a malicious campaign against his beleaguered company, which was recently made a subsidiary of Nordlin Co. "ARP has bad-mouthed us," he believes. "Said that we're going into the shithouse because Nordlin owns us but actually things have never been better. Anyone who says otherwise is full of it, and that's spelled s,h,i,t."

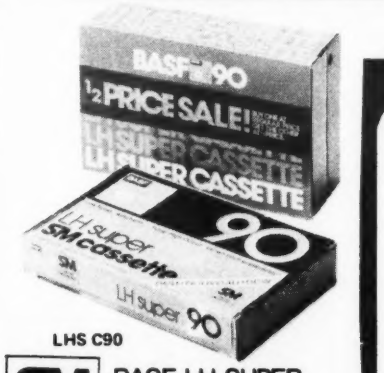
Moog says that his company does very little advertising, but that's because "we're making so many now, demand would soon outstrip supply." Meanwhile, Dumas, in addition to having garnered the public endorsements of over a hundred rock and pop stars worldwide, is gearing up for a national radio spot campaign featuring Herbie Hancock on ARP ("Hi, I'm Herbie Hancock. Get with it if you know what's happening and . . . .") And while Phil Dodds is snap-

Continued on page 30

the Coop

HARVARD SQUARE
M.I.T. STUDENT CENTER
CHILDREN'S HOSPITAL MEDICAL CENTER

90 MINUTE SALES SPECTACULAR. . .

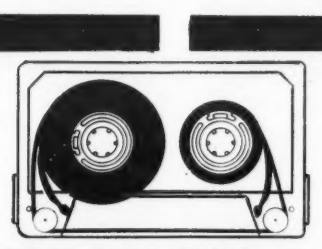


LHS C90

SM Special Mechanism

BASF LH SUPER
The super high output/ high density/ low noise cassette

LHS 2 FOR C-90 $4.40



SM Special Mechanism ®Exclusive BASF Special Mechanism assures jam-proof operation. It also assures smooth, positive tape guidance and precise tape-to-head wrap that eliminates distortion, dropout and wow in all of our cassettes. U.S. PATENT NO. 3841582

SKLH SP C90

SM Special Mechanism

BASF SKLH LOW NOISE - HIGH OUTPUT CASSETTES
with "Special Mechanism" Album snap pack - welded housing

SK-LH 2 FOR C-90 $3.40

BASF 8-TRACK CARTRIDGES SOUND LOOP/8+

The finest continuous-loop recording cartridges for stereo tape systems

BASF 8-Track SPECIAL

45 Min. — $3.19 For 2 (black)
64 Min. — $3.59 For 2 (black)
90 Min. — $3.79 For 2 (white)

The Ultimate In Professional Recording Tape

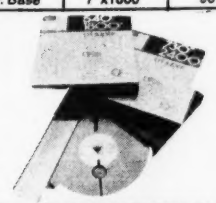
From The Inventor's of Magnetic Recording Tape

BASF Low Noise — High Output SUPER MAGNETIC TAPE LHS/Tensilized Base

TYPE	SIZE	RECORD TIME*	SUGGESTED LIST PRICE	1-9 pcs. 90 min. SPECIAL PRICE	CASE LOT 10 pcs.
Long Play LP 35 LHS 1 mil Poly. Base	7"x1800'	90 min.	$12.10	$7.19 ea.	$6.70 ea.

BASF Low Noise — High Output MAGNETIC TAPE LH/Tensilized Base

TYPE	SIZE	RECORD TIME*	SUGGESTED LIST PRICE	1-9 pcs. 90 min. SPECIAL PRICE	CASE LOT 10 pcs.
Long Play LP 35 LH 1 mil Poly. Base	7"x1800'	90 min.	$9.35	$5.30 ea.	$5.00 ea.



High Output SUPER MAGNETIC TAPE LHS/Tensilized Base

High Output MAGNETIC TAPE LH/Tensilized Base

If you think there's a cassette or cartridge better than Columbia's we'll buy it for you.

Just try a new Columbia tape. If you still like your old tape better, return the Columbia tape to us, and we'll send you the one you prefer. Free.

Our problem

Most people who buy recording tapes are pretty happy with what they're using. So it's hard for someone with a new tape—even someone with all the experience in music and electronics that Columbia has—to get people to try it. Regular advertising just won't work.

We realized we'd have to come up with a really unusual introductory offer. To really challenge people to try our new FAIL-SAFE cassettes and cartridges. To see that they really are better than other tapes.

Our offer

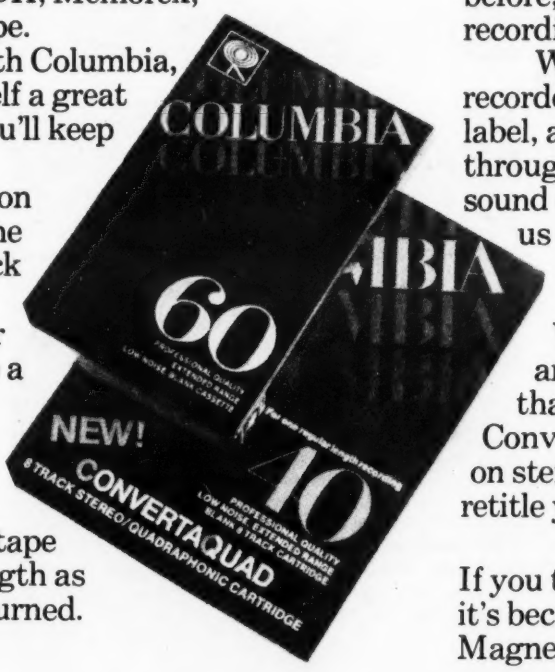
1. Buy a new Columbia cassette or cartridge in any length you like.

2. Try it out. Record on it. Compare it to the tape you've been using. TDK, Memorex, Scotch. Any iron oxide tape.

3. If you're happy with Columbia, fine. You've bought yourself a great new tape. And we hope you'll keep buying Columbia.

4. But, if for any reason you're not satisfied with the Columbia tape, send it back to us. With your receipt, no more than 30 days after you bought it, and include a label from the tape you prefer. Your only cost is 50¢ for postage and handling.

5. We'll send you the tape you prefer. In the same length as the Columbia tape you returned.



Our experience

We don't think we're taking much of a chance with this offer. And we don't think we'll be sending out many TDKs, Memorexes, or Scotches. Because while you may have never seen one of our blank tapes before, we're not exactly newcomers to the recording business.

We've made hundreds of millions of pre-recorded tapes over the years. For our own record label, and even for a lot of our competitors. And through that experience we learned a lot about sound quality and product reliability that helped us develop the best blank tape for home recording. With more highs and lows. Without fuzzing or blurring the sounds. Without jamming in any kind of tape deck in any kind of weather. And with unique features that make recording a pleasure. Like our ConvertaQuad cartridge that works automatically on stereo or 4-channel. And extra adhesive labels to retitle your tapes when you re-record.

Our challenge

If you think there's a tape that's better than ours, it's because you just haven't tried ours. Columbia Magnetics, CBS, Inc., 51 W. 52nd St., N.Y. 10019.

We want to change your mind

ARP

Continued from page 28

ping up idle TV repairmen in strategic cities and turning them into fresh-drilled recruits, Dr. Moog can only snap: "Why would we need all those service centers anyway, since ours don't break down as often as ARPs?

Turning to a brighter side, Moog told me that he was about to come out with his latest, the Micro-Moog, priced at under a thousand. But I had already seen the ARP Axxe — an identically priced machine with roughly the same components — in an ARP conference room. Had Dr. Moog heard? "The Wha . . .?" said the grand old man of electronica, his voice trailing off.

It all goes to show that you never should brush off a bright whiz kid's smart-alec questions at a science fair. And, undoubtedly, the crowning gimmick that has put ARP ahead was inspired by Friend's having to ask too many questions. Called "human engineering," Friend's idea was to develop a panel display system clearer and simpler to read than Moog's. Accordingly, he designed units with slide-pot switches to replace the dials that his competitor's models featured. You can use them at a glance, Friend says, explaining why more live rock performers buy ARPs. "There is an element of virtuosity to playing a synthesizer."

How this can be I couldn't tell. In my experience, virtuosity on a synthesizer with patch cords is like being busy at a switchboard (perhaps it is no coincidence that a Bell center abuts the ARP factory). Be it as it may, Friend's idea has caught on, and ARPs are now just a part of the act. It's the best advertising ARP gets, and it's free — ARP doesn't give away synthesizers to recording artists. "We're never into that kind of schlock promotional stuff," Friend says. Another secret, according to Friend, was inventing a machine that stayed in tune throughout a concert. His patented stable oscillator, he says, Moog now has copied. "If he hadn't, I'm afraid old Moog would be long gone by now."

*

Years have passed and now Friend can state that ARP is no longer the Avis of synthesizers. He recalls how in '69 he'd pack a unit in the back of his beat-up station wagon to market in New York, and get run out of hotels like the Ritz Carlton when the appalled doorman saw what he and Pearlman were carrying toward the elevator. "Moog's still an institution," he admits, "but that's because you see him interviewed in *Rolling Stone* here, doing a college talk there. That's fine with us. Just as long as we can keep the Doctor on the lecture circuit and out of the laboratory, I'm more than happy." As for expanding his sales, he can say with only a complacent, professional smile, "Yeah, I heard about how we sold thirty-eight to Iran. I can't imagine why. But I'm still working on mainland China. I want an ARP at the University of Peking in the *worst* way."

But wait. The battle isn't over yet, at least not behind the scenes in the vital research and development end of the business. There's a flicker of life still at the Williamsburg, New York plant of Dr. Moog. He prophesies the coming of Polyphonic War, which promises to be easily the most bizarre skirmish in the history of pop hardware commercialism. Within a year, Moog says, they plan to release onto the market a unit called the PolyMoog, which is capable of having all 72 notes of its keyboard struck simultaneously. "Each note will be in a different voice," he claims.

Now you can lie down on a Steinway grand and, if you're lucky, you'll hear 88 different notes. But what Moog will be offering is unprecedented in musical history. Until now, freak boxes could only freak you out with a maximum of four voices at one time, the reason being that such a chord would sound only like a mush, say, of tubas or violas. Moog's invention will automatically compensate for this by blending strings against woodwinds or any other combination. What Moog doesn't know, however, is that ARP's right on his heels. For discretion's sake, Friend tells me with a chuckle, he can't take me into the laboratory where he spends half his working day on ARP's latest secret synthesizer. But he does admit that ARP's tooling up their own polyphonic synthesizer for merchandising within a year. Please, don't ask details, he says, warding off my questions. Suffice it to say that somewhere out back is a whole workroom filled from floor to ceiling with electronics gear and that somewhere under all this stuff and a jungle of wiring is the keyboard. "Last time I saw it, I hit a 10-note chord and it came out sounding like a symphony orchestra."

So either Moog is jinxed, it's just coincidence, or ARP enjoys beating Moog down, one product line at a time. Very soon now, ARPs may be saying "Oh, yeah" in 72-part harmony. It should prove to be an interesting confrontation. If ever a man-made contrivance were capable of ringing in the Day of Judgment, both ARP's and Moog's polyphonia, set for trumpet blasts, should easily raise the dead. In the key signature of their choice.

*

Rumor has it that when Richard Carpenter started to play his new ARP string ensemble at a club rehearsal in Las Vegas, the amazed orchestra stomped out of the pit and refused to return until the instrument was removed from the stage. It seems that they considered the string sounds realistic enough to pose a threat to their acoustic violins, cellos and basses.

—ARPeggio

Will the real casualties in this electronic escalation be the traditional musicians? Friend says no, you can't ever replace the manual instrument. No, he isn't slowly phasing out the very artists who now hype his ARPs with a box full of wires. So far the union, American Federation of Musicians, hasn't officially accused any synthesizer company of putting its talent out of work. "It's still cheaper to hire a good horn man to play trumpet when you need just one," Friend says. But out back, on my tour of the factory, I caught a glimpse of two technicians stuffing a Fender guitar full of solid-state circuitry and memory chips. "Be sure not to print that," Friend said, somehow believing that the press too has now blended into his overall PR attack. "We don't want to give people the wrong idea."

What, then, is the idea? Will each studio feature just one good guitar player if ARP has its way? A threat exists, because synthesizers can make music; you can mambo to a moog and arropo to an ARP; Paraguay's already got a pair of Friend's top of the line 2500s. What does the future hold for, say, the blind banjo picker? Will he become another 'stop' on this new organ? If a Beethoven were born today, ARPspeak would assert, he would have to postpone the creations of his youth until his graduation from ITT tech. And little old ladies with their hair in a bun will lead our children through electronic chopsticks, rapping knuckles with their canes when the sine-waves aren't dancing properly across the oscilloscope.

Standing by the factory door on my way out, I reflected on ARP's advertising of Stevie Wonder. The culmination of his act, says a copy of *ARPeggio*, is his leaving the stage while his 2600 keeps on pounding out a beat and a melody. Eventually, the roadies go out to turn it off when the crowd has quieted. It isn't far-fetched to suggest that future Stevies may not trouble themselves with appearing at all. I've a feeling that if ARP can develop the necessary automating technology, they would prefer their unit to be lead man, with the Stevies in the wings watching their own programed acts. When and if this happens, how many good ARP players will we need to have just one kind of music?

In their upcoming polyphonic battle, Moog and ARP may rely on claims so esoteric as to leave us 100 percent baffled. How does a shopper accurately compare quality? Should we try testing ARP Natural Sound No. 53 — "Sporadic Heavy Breathing" — against the competition? (Trick noises are a good selling point, but the only discriminating judge of that would have to be the late Spike Jones.) The best solution I can suggest is for Moog to bring his equipment up to this headwater of the Charles, and place it alongside ARP, both preset for 150,000 Hz. If the dolphins off-shore hear the signals and are drawn upriver by the call, that's good enough for me; if it's music to them, I'll relax my aversion to electronic sonics — and buy one of each.

THESE CIRCUIT-SHATTERING "SHOCK" TESTS GUARANTEE THE CLASSIC QUALITY OF ONKYO SOUND

Hundreds of jarring, shattering, shock patterns that could destroy a lesser instrument. Then, follow this with punishing "drop" tests. But only after we've subjected our receivers, amplifiers, tuners and speaker systems to tough temperature/humidity extremes; abnormally high voltage inputs, circuit endurance checkouts and resistance-to-wear stress.

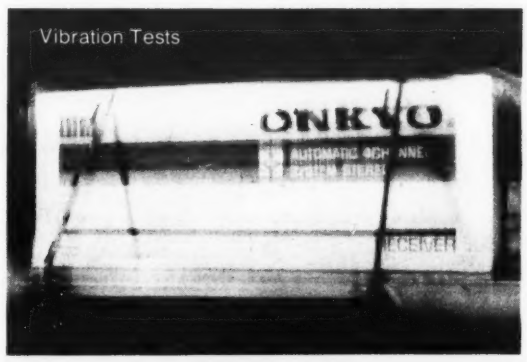
It's all part of Onkyo's unrelenting quality control procedure to guarantee product integrity under the toughest conditions. In that way, you can be sure that our totally engineered equipment will deliver total sound quality enjoyment in your home.

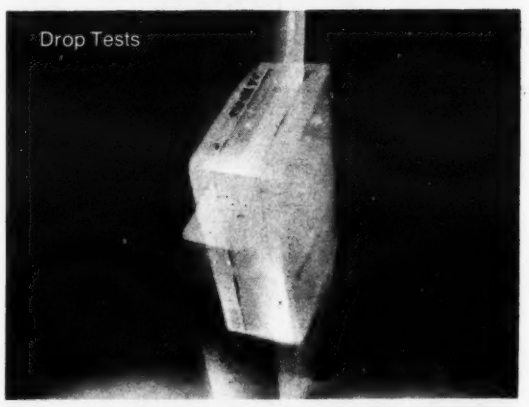
This Onkyo concept of "total engineering for total quality" starts with massive research data, computer analyzed to establish the highest standards. Component parts, circuits, transistors, etc., are chosen and checked for reliability and performance. And, whether it's our popular-priced Model 8, 2/Way Speaker System at $89.95 or our sophisticated, fully automatic, 4-Ch Receiver at $749.95, Onkyo's precise, dedicated craftsmen commit themselves to distinctive quality.

Of course, the ultimate test is performance. Consider this. Onkyo developed an ideal Transient Response — the ability to reproduce a complex sound signal faithfully and without change — because it's as important as harmonic distortion content. That goes for speaker systems as well as electronics. What's more, Onkyo research determined that "Energy Response" — the ability of a speaker system to provide full, rich sound both *on-and-off axis* — is the key to sound quality. For the acid test, Onkyo conducts impartial listening sessions before a panel of audio critics. After all, it's what you hear that counts.

How do leading audio experts evaluate Onkyo? They've been more than impressed with the quality & design. Just read this: Recently, High Fidelity magazine (Jan. '75) Test Equipment Profiles said that our Model TX-560 Stereo Receiver delivers "Quality and Flexibility" in keeping with the phrase "Totally Engineered". FM Guide magazine (Dec. '74), the Feldman Report said about our TX-330 Stereo Receiver "At under $300, it earns a very high lab rating . . . we had the distinct feeling that we were dealing with a much more expensive set".

Now it's up to you. You can listen to Onkyo. And compare the quality, performance and craftsmanship. You can discover why Onkyo has been an audio innovator for more than 28 years. See your dealer. Onkyo has the quality speaker systems and electronics priced to suit your requirements. You won't have to go through shock tests to make a decision.





ONKYO®
Artistry in Sound

Onkyo Sales Section/Mitsubishi International Corp.

Eastern Office: 25-19 43rd Ave., Long Island City, N.Y. 11101 (212) 729-2323

Midwest Office: 935 Sivert Drive, Wood Dale, Ill. 60191 (312) 595-2970

Listen to Onkyo sound at these dealers

ATLANTIS SOUND — Boston, Braintree, Cambridge, Framingham, Peabody, Providence, R.I. • **SUFFOLK AUDIO** Cambridge, **COPLEY CAMERA** — Boston • **K&L SOUND** — Watertown • **TECH HI-FI** — Amherst & Northampton • **SOUND SALES STEREO OUTLET** — Fitchburg • **LINEAR SOUND** — Worcester • **SEIDEN SOUND** — Pittsfield & Amherst • **AUDIO DEN** — South Burlington & Middlebury, Vt. • **AUDIOPHILE STUDIO** — Greenland & Newmarket, N.H. • **STEREO PLACES** — N. Providence, R.I. • **N.E. MUSIC** — Bangor, Lewiston, Portland & Waterville, Me. • **ROBERTS ELECTRONICS** — New London, Ct.

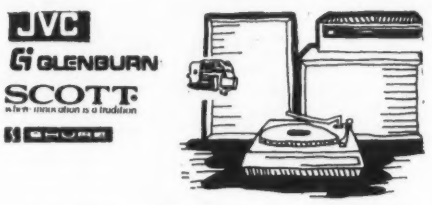
K&L SOUND'S SPRING DEMO SALE

The Biggest Used HiFi Sale in Boston History

On Monday, March 18, the doors at K&L Sound will open at 10:00 for our annual Spring Demo and Used Sale. We'll clean house and you'll clean up on some of the greatest hi fi bargains available in years. Many demo units have only a few hours use and all carry full manufacturers warrantee. Take advantage of these hi fi bargains now. For prices see the fine print specials below.

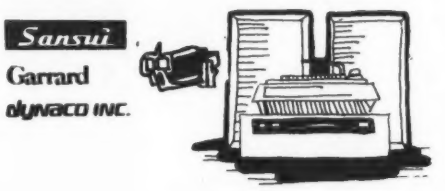
ROTEL RX-200A • 8 watts RMS per channel (measured at 8 ohms, 20-20,000 Hz below 0.5% distortion)
GLENBURN 2155 • heavy duty induction motor • damped cue • anti skate
JENSEN 1 • 8" coaxial driver • 120° dispersion • frequency response 45-18,000 Hz
SHURE M75ECS • magnetic eliptical cartridge

List Price $387 — K&L Price $189.95



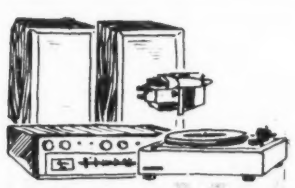
JVC 5505 • 8 watts per channel RMS (measured at 8 ohms, 20-20,000 Hz below 1.0% distortion) • FM sensitivity 2.2 *uV*
GLENBURN 2155 • heavy duty induction motor • damped cue • anti skate
SCOTT 42 • 8" woofer • dome tweeter • frequency response 42-19,000 Hz
SHURE M75ECS • magnetic eliptical cartridge

List Price $443 — K&L Price $284



SANSUI 551 • 16 watts RMS per channel (measured at 8 ohms, 40-20,000 Hz below 0.8% distortion)
GARRARD 42 • damped cue • wood base • magnetic cartridge
DYNACO A-25 • 10" woofer • dome tweeter • frequency response 39-20,000 Hz

List Price $547 — K&L Price 379.95



SONY 7025 • 18 watts RMS per channel (measured at 8 ohms, 40-20,000 Hz below 0.8% distortion) • FM sensitivity 1.7 *uV*
BSR 2620W • synchronous motor • damped cue • wood base
SCOTT 52 • 10" woofer • dome tweeter • frequency response 37-20,000 Hz
ADC K5E • magnetic eliptical cartridge

List Price $639 — K&L Price $450

ALTEC 710 • 30 watts RMS per channel (measured at 8 ohms, 20-20,000 Hz below 0.5% distortion) • FM sensitivity 2.4 *uV*
GARRARD 82 • synchronous motor • damped cue • anti skate
CERWIN VEGA 24 • 12" woofer • dhorm tweeter • frequency response 33-22,000 Hz
STANTON 500E • magnetic eliptical cartridge

List Price $812 — K&L Price $550

ONKYO TX-666 • 48 watts RMS per channel (measured at 8 ohms, 20-20,000 Hz below 0.3% distortion) • FM sensitivity 1.8 *uV*
TECHNICS by PANASONIC SL1300 • direct drive motor • speed strobe • variable pitch
CERWIN VEGA 211R • 12" woofer • dhorm tweeter • rear firing horn
AUDIO TECHNICA AT-13E • magnetic eliptical cartridge

List Price $1414 — K&L Price $999.95

Hours: Mon.-Thurs. 10 - 10
Fri. 10 - 6 Sat. 10 - 5
We are not your stereo typed stereo store

K+L SOUND SERVICE

Remember to call and make sure you're getting the lowest price.
75 N. Beacon St. Watertown 787-4073

Check last week's paper for all the New Specials

THE BIGGEST *USED* HIFI SALE IN BOSTON HISTORY

All Sales Final (demos & new equipment have manufacturers warranty)
Used items, check with salesmen for warranty info

RECEIVERS

Sherwood S8900A demo	439.95	300.00
JVC 4VR5 46 used	679.95	
Nikko STA9090 demo	499.95	350.00
Nikko STA5050 (2) demo	249.95	175.00
Nikko STA6060 demo	319.95	225.00
Onkyo TX560 demo	449.95	300.00
Fisher 504 new	600.00	400.00
Scott R75S demo	400.00	300.00
Sony 6036A demo	229.95	150.00
Altec 714 (2) repack	450.00	250.00
Altec 714 demo	450.00	250.00
Marantz 4220 demo	299.95	150.00
Onkyo TS500 demo	700.00	420.00
Kenwood KR4400 demo	300.00	185.00
Kenwood KR1400 demo	180.00	105.00
Rotel RX150A used	149.95	75.00
Rotel RX600A repack	349.95	200.00
Yamaha CR700 used	379.95	250.00
JVC VR5535 demo	429.95	258.00
JVC VR5525 demo	369.95	225.00
Sansui QR500 demo	249.95	125.00
Scott 387 demo	379.95	200.00
Pioneer SX525 used	259.95	165.00
Fisher 201 used	230.00	100.00
Pilot 252 demo	319.95	165.00
Standard SR207 used	130.00	65.00
Kenwood TK66 used	240.00	100.00
Sansui 210 used	179.95	100.00
Scott R335 demo	250.00	160.00

REEL TO REEL TAPE DECKS

Teac 3300-10 repaired	590.00	400.00
Dokorder 9200 demo	899.95	550.00

CASSETTE DECKS

Teac 360S demo	379.95	275.00
Advent 201 (4) repacks	299.95	200.00
Dokorder MK50 (4) repacks	199.95	140.00
Teac 210 (2) repacks	190.00	125.00
Akai GXC46D demo	289.95	210.00
Sony TC152SD demo	349.95	275.00
Wollensak 4770 repaired	199.95	120.00
Sony 161SD demo needs work	299.95	175.00
Technics RS6 10US demo	249.95	175.00

8-TRACK

Akai GXR82D demo 1 day old	199.95	140.00
JVC ED1230 demo never used	129.95	90.00
JVC ED1240 demo	169.95	120.00

COMPACTS

KLH 11W used, new stylus	209.95	125.00
Benjamin 2032 repacks	300.00	150.00
Rolecor RTA420 repacks	199.95	75.00

ACCESSORIES

JVC 4DD5 demo	129.95	75.00

POWER AMPS

JVC VB100 repaired	259.95	125.00
Dynaco ST400 (2) demo	669.95	400.00

AMPLIFIERS (integrated)

Scott 255S demo 30/30 RMS	229.95	150.00
Kenwood KA6004 demo 40/40 RMS	299.95	200.00
JVC VN900 used 50/50 RMS	399.95	240.00
Rotel RA110A repack	59.95	30.00
Onkyo A7022 demo 48/48 RMS	369.95	250.00
Rotel RA1210 demo 60/60 RMS	399.95	225.00

PREAMPLIFIERS

SAE MkIX new	500.00	350.00
SAE MkXXXI demo	275.00	175.00
Crown IC150 demo	349.95	265.00

TUNERS

Kenwood KT6005—1 demo	299.95	200.00
—1 used	299.95	175.00
Kenwood KT8005 demo	389.95	235.00
Sansui TU505 demo	179.95	100.00

SPEAKERS

Advents Large repack	258.00pr	180.00pr
ESS AMT 1 used	600.00pr	350.00pr
ESS Tempest used	300.00pr	175.00pr
Infinity 2000AXT (4) demo	600.00pr	400.00pr
JBL L25 demo	250.00pr	160.00pr
Onkyo 25 demo	500.00pr	300.00pr
Micro/Acoustic FRM1 demo	360.00pr	180.00pr
JBL L88P with blown woofer as is	450.00pr	200.00pr
Ohm B demo	440.00pr	275.00pr
Bic Ventury 6 used	540.00pr	300.00pr
Advent 12 used	116.00pr	75.00pr
Infinity Monitor demo	858.00pr	650.00pr
Infinity WTL demo	480.00pr	360.00pr
KLH 31 demo	100.00pr	60.00pr
Rectilinear XIA demo	200.00pr	120.00pr
Janszen Z410 demo	400.00pr	200.00pr
Cerwin Vega 24 used	260.00pr	200.00pr
Cerwin Vega V8 demo	160.00pr	100.00pr
KLH 32 demo	125.00pr	70.00pr
Pioneer Project 60 demo	160.00pr	85.00pr
Pioneer R300 demo	300.00pr	150.00pr
Altec Stonehenge I (4) demo	640.00pr	400.00pr
Altec 886A demo	320.00pr	180.00pr
Altec 891A demo	300.00pr	180.00pr
Scott S71 demo	400.00pr	250.00pr
Ohm E used	180.00pr	100.00pr
AR3 used	450.00pr	200.00pr
Ohm F used	900.00pr	550.00pr

TURNTABLES

Glenburn 2155AQ new	142.35	75.00
Garrard Zero 100SB demo w/ADC26	209.95	150.00
Rabco SL8E tonearm used	199.95	100.00
Empire 598 11 used	299.95	150.00
JVC VL5 (2) repaired	129.95	85.00
Rotel RP1000Q repaired	129.95	85.00
Lenco L85R used	249.95	135.00
Lenco L75 demo	149.95	75.00
Sony PS5520 demo	189.00	110.00
Thorens TX165C repaired	199.00	140.00
Garrard Zero 100S used	199.00	100.00
Thorens TD125B repaired	305.00	200.00
Stanton 8004 w/Stanton 681EEE demo	199.00	125.00
Fisher turntable used	80.00	20.00

I Hear No One When There's Music There

Welcome to a chamber of horrors

By Clif Garboden

Each stereo speaker, headset and microphone that is tossed into the marketplace competes for our affection (and money), armed with an impressive and ever so technical-looking sheaf of papers which inevitably includes at least one graph demonstrating the product's "response curve." Such a graph plots a speaker's ability to reproduce any given inut tone, (frequency, sound wave, cps, Hz, by any other name, whatever), in terms of volume (decibel level). The curve points out the relative strengths and weaknesses of a speaker by telling us exactly what sounds will be more audible than others.

Reading these curves is complicated enough; drawing them involves a setup so complex as to be downright spooky. Loudspeakers are tested in weird little rooms called anechoic chambers. (That's "an-a-co'-ic.") The famed Cambridge acoustical research firm, Bolt, Beranek and Newman, houses such a contraption in the basement of its offices at Fresh Pond.

From the outside the anechoic chamber looks like the cell where the mad scientist in the monster movies stores his early experiments. When you open the all-but-creaking door you expect some mutant's scaly hand to shoot out and clutch you by the throat. Or it reminds you of the entrance to a gas chamber or a bomb shelter or some other place where if you went in you would never come out.

Clif Garboden

Chamber-reading

Once you're inside, these morbid associations are undiminished by the decor. The chamber, a cozy eight-foot cube, is lined with strips of dirty pink fiberglass insulation set in edgewise around the walls, floor and ceiling. You stand undulating on a rat-wire catwalk suspended above the padded floor. It's just the right environment for an execution.

The only props on the set, in fact, are some wires dangling out of the wall (where they plug in the electrodes from the victim's head) and a half-inch lead pipe jutting down from the ceiling (for the gas). But actually, nobody's making B movies in this room. This pit — this benighted underfurnished hole in the wall — is a scientific instrument. The pipe is nothing more than a place to hang microphones. The wires are to hook up a speaker (or any other noisemaker). Situating the dangling mike such that it points directly at the center of the speaker creates the perfect arrangement for measuring the pure "on axis" response of the noisemaking unit — but only in this room.

Why here? Because this is a dead room. No, not a room of the dead, although being inside for a while does give one an appreciation for the term "quiet as a tomb." The wall covering is constructed of sound-absorbing wedges of insulation cut to be at least one half as deep as the longest wavelength measured in the chamber. These wedges prove extremely efficient at not reflecting any of the noise generated within.

When a speaker, or a foghorn for that matter (B B & N once tested a foghorn), broadcasts a sound, it travels directly to the opposing microphone. Because of the extreme vibration dampening characteristics of the anechoic chamber, the broadcast sound reaches the microphone only once. No sound is reflected from walls, floor or ceiling. What this means in terms of testing speakers is simply that the microphone picks up precisely the volume of sound that the speaker is capable of sending, without regard to any variable acoustical properties.

The sound that's picked up by the mike is fed back into the machine that generated the pure test tone in the first place — a remarkable piece of engineering that receives, measures and records the db level of a sound on its return trip through the chamber. The testing unit is capable of generating, sending and welcoming back a complete sequence of pure tones between 20 and 20,000 Hz and printing out a

Continued on page 38

STEREO DISCOUNTS

BOSTON'S LOWEST PRICES ON STEREO SYSTEMS

SHOP BY PHONE AND COMPARE DISCOUNTS UP TO 40% OFF

All New • All in Cartons • All Guaranteed

YOU CAN CHOOSE FROM THE VERY BEST

ADC	BSR	Fisher	Miracord	Scotch	TDK
Akai	Concord	Garrard	Onkyo	Sennheiser	Teac
Altec	Craig	Jensen	Panasonic	Sherwood	Technics
AR	Dual	Kenwood	Pickering	Shure	Telex
Audioanalyst	Dynaco	KLH	Pioneer	Sony	Thorens
BASF	Electrovoice	Koss	Rectilinear	Stanton	Wharfedale
Bozak	Empire	Lenco	Rotel	Superex	Wollensak
		Marantz	Sansui		

SHOP THE TOWN AND THEN GET OUR PRICE

ARKAY HI-FI

68 Watertown St., (Rt.16), Off Watertown Sq.

Open 10-6. Wed. & Thurs. 'til 8:30

Free Parking - phone 924-1067

DID YOU KNOW —

— that BSEM now offers a two-semester program of studies, from basic principles to tape composition, live improvisation, and keyboard performance?
— that we are authorized dealers for every major synthesizer manufacturer?
— that we were the *first* independent school of electronic music in the country when we started three years ago?
— that we recently completed a $23,-000 installation at a major Connecticut university?
— that we are *the* people to come to for friendly, *complete* attention to all of your questions, and for experienced, unbiased consultation, modifications, custom work, service, and "those accessories that nobody else has?"
— that students have enrolled at BSEM from as far away as Tel Aviv?

NOW THAT YOU KNOW —

— when you call, ask for Eric.

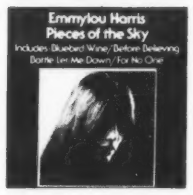
(617) 261-1634

The Boston School of Electronic Music

326 Dartmouth Street
Boston, Mass. 02116

Want a free album ?

We'll also include an appropriate Audio-Technica cartridge at no extra cost! Need more incentive?



PIONEER **only $99** audio-technica

LONNIE LISTON SMITH
& THE COSMIC ECHOES
EXPANSIONS
Includes Expansions · Desert Nights
Summer Days · Voodoo Woman
Peace · Shadows · My Love

Investing a small fortune on albums? Don't overlook the value of a fine turntable such as the **PIONEER PL12D.** Its low friction tonearm coupled with an **AUDIO-TECHNICA AT10 CARTRIDGE** will help keep your records sounding like new.

Records courtesy of POPCOP THE record buyers' guide

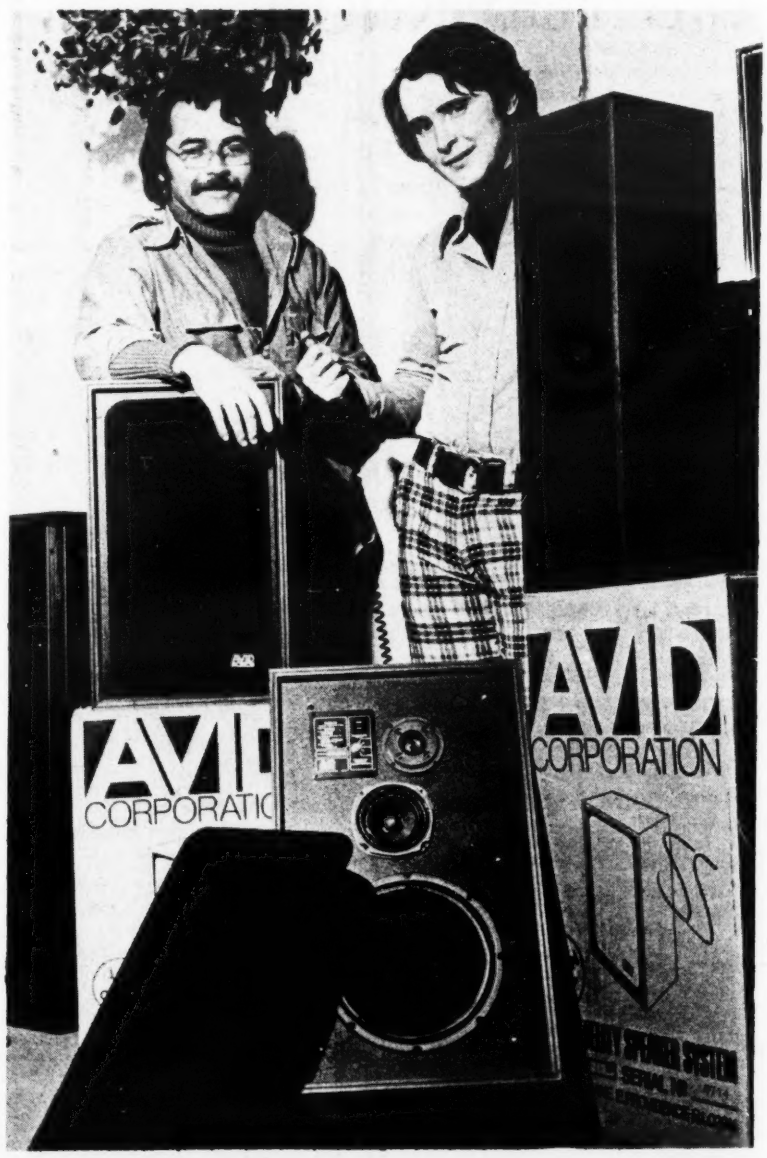
Did you know that **STEREO SOUND** carries more lines of turntables than any other dealer in the Boston area?
Choose from **AR, BENJAMIN, B.I.C., B&O, BSR, DUAL, GLENBURN, KENWOOD, PE, PHILIPS, PIONEER, SANSUI, TECHNICS** and **THORENS.**

STEREO SOUND

Harvard Square
16 Eliot Street • 864-4115

Kenmore Square
468 Comm. Ave. • 261-1155

Burlington
Rte. 3A, Near Building 19½
273-1105



If only pictures could speak!

Then you might know how great we think the Avid loudspeakers sound. But don't take a picture's word for it — come in for a listen.

AVID

STEREO SOUND

Harvard Square
16 Eliot Street • 864-1155

Kenmore Square
468 Comm. Ave. • 261-1155

Burlington
Rte. 3A, Near Building 19½
273-1105

So What Else Is New?

ADS: GOING MOBILE

Now you can have genuinely hi-fi sound in your car, boat, plane, camper, mobile recording van — or wherever high-quality music reproduction is needed, space is limited, and only 12V DC is available.

How? The ADS 2001, which is a miniature, high performance, high power, bi-amplified speaker system which will set the standard by which all mobile speaker systems will be measured in the future.

A tiny (four-inch diameter) precision woofer had to be developed by ADS engineers; it compares in overall power handling and its ability to move air to a six-inch woofer.

This driver was combined with a one-inch soft-dome tweeter derived from the uniformly excellent model already installed in the entire stationary ADS line as well as in the tri-amplified BRAUN LV 1020 studio speaker. Matched in a minute, high impact precision metal cabinet, this combination is the visible outlet of ADS's 2001 system. The open clarity and exact response, which have been the consistent design criteria for all ADS speakers, have now been extended into a miniature package.

Of course, sophisticated electronics were necessary to make this possible. A minimum of 160 watts of sine-wave power, provided by four independent Darlington power amplifiers is available for woofers and tweeters, coupled with electronic cross-over networks (active filters), equalizers and opto-electronic limiters. The high amplifier power level could only be achieved with the help of a high frequency DC-DC switching converter operating at 25,000 Hz. This module, originally invented for satellite use, can provide well over 350 watts of electrical power to the amplifiers from an ordinary 12 V car battery.

PIONEER PL-12D/II TURNTABLE

U.S. Pioneer Electronics Corp. has just introduced a new low-cost, belt-driven turntable/tonearm combination which is supplied complete with its own electrically shielded, spring suspension wood-grain base and hinged dust cover. The Model PL-12D/II employs a belt-drive system with a four-pole synchronous motor for stable, accurate speed rotation. Its zinc die-cast 12-inch platter rotates at precisely 33-1/3 or 45 rpm regardless of line voltage fluctuations. Signal-to-noise ratio is better than —48 db, while wow and flutter is not greater than 0.08 percent, wrms.

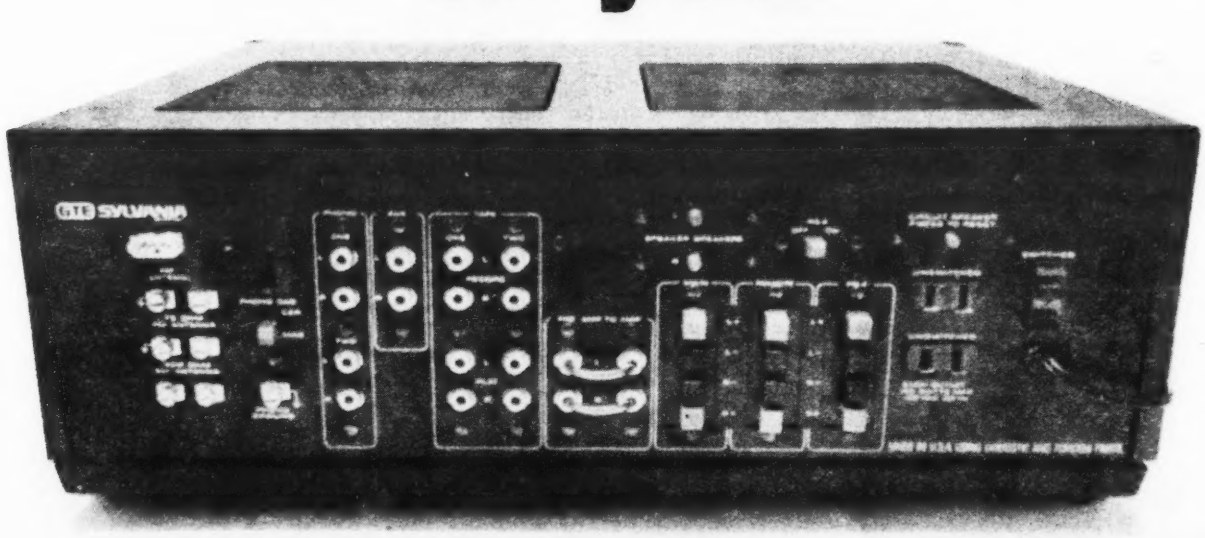
The statically balanced, S-shaped tonearm of the PL-12D/II pivots on a point of super hard alloy for reduced friction and improved tracking. An accurately calibrated anti-skating control is conveniently positioned and is independent of the tonearm. A lightweight plug-in cartridge shell accepts cartridges weighing up to 10 grams and, together with a built-in stylus gauge, permits precise overhang adjustment. Damped tonearm cueing combined with the power on/off lever prevents accidental damage to records. A direct reading stylus force scale incorporated on the adjustable counterweight permits tracking forces as low as 0.75 grams. The wood-grain base of the PL-12D/II is lined with aluminum foil on its inner surface to prevent electrically induced noise which might be caused by nearby components. Special spring suspension mounts reduce external vibration. A removable, free-stop hinged dust cover protects the entire mechanism and records even while the unit is operating.

The PL-12D/II is designed to operate on 120 V, 60 Hz and consumes 11 watts of power, maximum. Price: $99.95.

SANSUI'S NEW FOUR-CHANNEL RECEIVER, MODEL QRX-7001

This unit features a built-in IC vario-matrix chip for activating both QS and SQ decoders, achieving 20 db separation, and is the first receiver to use the most advanced front/back, left/right independent control logic (not to be confused with so-called gain riding logic) for ideal four-channel sound field separation. The Model QRX-7001 contains a QS synthesizer also capable of supplying 20 db separation, thus supplying existing stereo records with unusual presence. It also contains a built-in CD-4 demodulator. Excellent FM, AM; 140 watts total; much flexibility; $880.

We're not afraid to turn our back on you.



Introducing the RS 4744

We can afford to be very forward about our back.

Because the back of our RS 4744 stereo receiver is one of the most versatile you'll ever see. We've got phono inputs for two different turntables. And two sets of tape monitor input and output jacks. And terminals for main speakers, remote speakers, and PQ4 speakers. And three AC power outlets, one switched and two unswitched. The rest you can see for yourself in the picture above.

But what's behind our back is just as impressive as the back itself.

As *Popular Electronics** put it, the RS 4744 "met or surpassed all the published specifications we were able to test" and was "...well above average in the important performance aspects."

Take power, for example. *Popular Electronics* found the RS 4744 "conservatively rated" at 60 watts per channel, min. RMS at 4 to 8 ohms from 20Hz to 20kHz with no more than .25% Total Harmonic Distortion. Which made it "outstanding for a receiver in the RS 4744's price range." FM 50 dB quieting sensitivity was equally impressive—"a very good 3μv in mono and 35μv in stereo."

But don't take our word for it. Or their word for it. Go see the RS 4744 for yourself.

Back or front, any way you look at it, the RS 4744 is one fine stereo receiver.

*Popular Electronics, December 1974 Issue.

GTE SYLVANIA

Woofing

Continued from page 12

actual efficiency (assuming good design) is directly proportional to cabinet size, inversely proportional to the radiation angle provided by the room boundaries where the system will be used, and directly proportional to the third power of the low cutoff frequency. Three of these factors — size, efficiency, and cutoff frequency — can be juggled at will by the designer. When the highest possible efficiency must be obtained, a bass *horn enclosure* is indicated. A horn is self-descriptive except for its size, which must be really huge for good low-frequency response, and except for its price, which must be large also because of the construction complexity. Unfortunately, a bass horn's response will suffer if it is reduced in size, so there is hardly room for compromise.

One other category of woofer enclosure remains: resonant pipes and columns. Over the years there have been an infinite variety of such enclosures; some contained a single column or pipe, others had multiple pipes of different length. Woofers used with them have been mounted in various ways. Currently the most popular variant of this group is called the *transmission line* system. A bass transmission line is a folded pipe construction, with the back side of the woofer driving one end of the pipe and the other end open to the room. The pipe may be tapered, with the speaker at the large end; usually it is filled loosely with damping material.

An open-ended column such as this has a resonance at the frequency for which it is one-half wave length (50 Hz for a pipe 11¼ feet long), and at this frequency the pipe's output is additive to the direct woofer output. Reinforcement at a significant level requires that the column have an appreciable cross-section area; if the folded tube is 10 feet long or more, a rather large cabinet is needed for a transmission line — significantly larger, in fact, than would be required for either a bass-reflex or an acoustic suspension system of comparable low-frequency performance and efficiency.

HEIL SPEAKERS

Sound that recreates the live performance was the design objective of the Tempest Lab Series — the first super-high-efficiency bookshelf line to incorporate the Heil air-motion transformer tweeter. The Series combines this revolutionary tweeter developed by the noted physicist, Dr. Oskar Heil, with a long-excursion, high-power-handling woofer.

This new series of four loudspeakers is so extraordinarily efficient that each requires only one-half the power of any other bookshelf system (and one-tenth the power of most). Great clarity and impact is the achievement of the new Tempest — a speaker capable of lightning-like high frequency output and dispersion, and bass attacks that approach the intensity of sound pressure level of the live performance. The Tempest makes such sound possible with amplifiers of only 10 watts RMS output.

The response accuracy and sound dispersion of the world-acclaimed Heil air-motion transformer is due to a revolutionary speaker principle: unlike conventional transducers, *e.g.* cones, domes, electrostatic panels, piezoelectric materials and traveling wave systems that push air directly, the Heil air-motion transformer diaphragm can accelerate air to a speed more rapid than its own moving surfaces — *five times* more rapid. It does this by "squeezing" rather than "pushing" the air.

The Tempest Lab Series comes in walnut vinyl with a choice of brown, blue or rust-colored foam grilles. Unit list prices range upward from $99.

TEAC HEADPHONES

With the TEAC HP-100, your head is locked into the full dynamic world of stereo — yet is not locked out of the other world around you.

Conventional stereo headphones transmit sound in varying degrees of range and fidelity. Problem is, the better ones fit so snugly that you are unable to hear the phone, doorbell or other room sounds that may be important to you. The *directional* high velocity principle employed by TEAC lets you hear music with stunning clarity, yet permits you to hear those critical outside sounds.

ADVENT: I CAN TURN A TUNER

Advent Corporation announces the introduction of a new product, the Model 400 FM Radio. The Advent FM Radio is a system consisting of two compact sections housed in matching white molded cabinets: a monophonic FM receiver and a separate acoustic-suspension speaker system. It offers a level of performance, particularly in its overall useful frequency band-width and acoustic output, that is unmatched by any other FM table radio and that is unprecedented for a complete music system of its size, price, and operational simplicity. Its suggested retail price is $125.00.

The Advent FM Radio will provide highest quality sound in countless places — dorms, offices, stores, eating places — where component sound systems are too elaborate or expensive.

The separate receiver and speaker system combine utmost flexibility in placement with minimum intrusion of the equipment into a room. The receiver may be placed where it is most convenient to operate, and the speaker placed where it sounds best. A 40-foot speaker cable is provided to encourage such placement; however, both sections are styled to take on the appearance of a single unit when they are placed side-by-side if preferred.

The tuning circuitry of the Advent FM Radio is the result of a thorough re-examination of FM tuner parameters, particularly those that contribute to highest performance from a mono FM radio. Among the reasons for this special design emphasis is the knowledge that the Advent FM Radio is likely to be set up and used more casually than an elaborate component system.

The speaker driver is of acoustic-suspension design, with a cone area, excursion capability, and magnetic structure sufficient to provide solid bass response at surprisingly high levels. At the same time, the cone is small enough for extended high-frequency response.

Combined with the speaker driver, and as important to the sound of the Advent FM Radio as that driver itself, is an LCR network, used here with a single, full-range driver for the first time in a consumer product. The LCR network shapes or "contours" the speaker's response to achieve an octave-to-octave tonal balance chosen to be satisfying on a wide range of source material under a wide variety of listening conditions. This network controls final subtleties of tonal balance that are virtually impossible to achieve when depending upon a speaker driver's inherent performance alone.

KENWOOD'S NEW TURNTABLE

Kenwood, well-known for its receivers, amplifiers, and tuners, is introducing yet another dimension to its hi fi component line with two turntables, designated KP-5022A and KP-3022. The KP-5022A incorporates a direct-drive system powered by an eight-pole brushless 24-slot DC motor coupled to the center of the turntable. This direct-drive system reduces wow and flutter to less than 0.05 percent and improves rumble signal-to-noise ratio to greater than 58 db. Since there are no belts or idler pulleys to wear out or change characteristics, the unit's accurate speed and fine performance remain constant over years of use.

The KP-3022 utilizes dual synchronous motors — one for the precision belt-driven turntable and one for the tone arm. A belt-speed reduction system between the four-pole synchronous motor and the solid die-cast aluminum alloy, 12-inch turntable effectively absorbs residual vibration from the motor. Because the drive belt is fabricated to extremely close tolerances and held securely in place by an invisible driving rim, wow and flutter are reduced to less than 0.08 percent.

Both the new Kenwood turntables feature a statically balanced tubular arm with an elliptical cross-section, die-cast aluminum shell and carefully fabricated parts to cut resonance to extremely low amplitudes well below audible limits. Tracking force is directly calibrated and can be read with 0.25 gram accuracy. Shell position is fully adjustable so that stylus contact with the record occurs at precisely the right angle, insuring optimum channel separation for stereo, matrixed, or CD-4 records. The units feature automatic repeat play, arm return, power shut-off, anti-skating adjustment. The KP-5022A also features a stroboscope speed adjustment.

The KP-5022A has a suggested retail price of $319.95 and the KP-3022 a suggested price of $199.95.

THE POWER of an EARTH QUAKE by

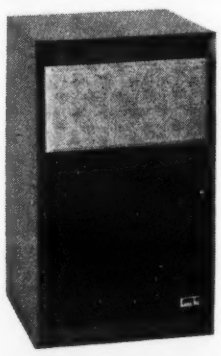
Cerwin-Vega

When Hollywood wanted to reproduce the awesome power of an earthquake in theaters across the country, they turned to CERWIN-VEGA because of their reputation as the finest speaker manufacturer in the country. Bass notes so low and clean that they defy description even though most people are amazed by the definition and transparency of the mid-range and treble. Couple this with the fact that it takes very little power to produce earth shaking volume and you have an exceptional speaker. Even more exceptional is that all CERWIN-VEGA loudspeakers are guaranteed for *LIFE!*

The complete line of CERWIN-VEGA products are on display at K&L SOUND in Watertown. We even have a limited, free supply of the earthquake sound effect records for you. Hear what a 15 cycle note sounds like on a CERWIN-VEGA speaker, and then try it on your own speakers or a competitors best line and hear the difference for yourself.

MODEL 24

- 12" woofer
- dhorm tweeter
- frequency response 33-22,000 Hz
- one watt sensitivity 94db



MODEL 211R

- 12" woofer
- dhorm tweeter
- mid-range horn
- frequency response 32-20,000Hz ± 3½ db

MODEL 211

- 12" woofer
- dhorm tweeter
- frequency response 32-20,000 Hz ± 3½ db
- one watt sensitivity 98db

MODEL 217R

- 15" woofer
- 2 dhorm tweeters
- mid-range horn
- frequency response 30-20,000 Hz ± 3½db

Cerwin-Vega

Cerwin-Vega speakers start at **$79.50**

is only found at

K+L SOUND SERVICE

75 N. Beacon St.
Watertown, Mass.
787-4073

Eras

Continued from page 22

I keep three cartridges and a half-dozen styli in my living room to use with a modern variable-speed turntable specifically for playing old records.

(An aside for those who want to do likewise and want suggestions about equipment: you can play most, but not all, old records on any turntable having the 78 speed and with any pickup for which an appropriate accessory stylus is available. Of the current turntables capable of encompassing the range from the slower Victors of the acoustic era — around 72 rpm — to the early center-start Pathes — 90 rpm — I prefer the Lencos to the Rek-O-Kut because of the arm. The Lenco's anti-skating control, for one thing, is almost a necessity for playing Pathe "hill and dale" discs. There is a new model on the way from a company called Martex that may turn out to be the best of the lot for *all* kinds of records: extremely low rumble for LPs, for instance, plus a wide speed range for everything else. For playing any hill and dale discs, plus the lateral (or "needle cut") ones with oddball groove dimensions, there is no substitute for the styli and cartridge (actually, a Shure) offered by International Observatory Instruments of Lexington, Ky. For the electrically cut discs, particularly the late ones, the Shure V-15 Type III, with an accessory three-mil elliptical stylus, is great. It often reveals detail you'd otherwise never suspect was there. And finally, I keep on hand one of the original G.E. Variable Reluctance pickups, which will handle high recorded levels like no modern LP cartridge — which both of the others essentially are. The hang-up here is that I can no longer get replacement diamong styli for it; I use it aparingly. I'm told there is a company in England that will custom-grind styli and mount them on your cantilever. Eventually, I'll have to look into that.)

I prefer to use modern equipment for two reasons: the sound quality I can get and the groove damage I can avoid. But because of the mind's role in the listening experience, some odd things happen when I listen to a tape dub offering the same sound. If I've made the tape dub myself and therefore know exactly what went into it, I enjoy the tape as much as the discs. In playing somebody else's tape, I generally find the experience sonically satisfying in direct proportion to the information given me about the original discs.

I think this is because, in the act of handling and playing the old discs, one learns to make certain assumptions about the quality one can expect. Again, it's a matter of learning through experience. By the time you have felt the weight of the disc in your hand, examined its label and set it in playing position on the turntable, you have unconsciously primed yourself for the sort of sound you will hear: your hearing is pre-tuned to the kind of noise and distortion and frequency response that the disc will offer. And eventually, a detailed listing of label and date and so on can be an adequate substitute for handling the disc.

In a sense, all of these sonically extrinsic clues help because they evoke the period. And it is only in this sense that I can see the point of playing old records on old equipment. When you have tightened the screw holding a new (or newly sharpened) needle, wound up the motor and adjusted the morning-glory horn, you're no longer aware of the TV set by the fireplace. A world in which operas are normally presented on disc in 35-minute record sides is behind you. Three or four minutes of Tetrazzini or Ruffo is all you can expect at a clip, and for that moment you are privileged to welcome the voices of the great into your Edwardian parlor.

Well, I can do quite nicely, thank you, with the disc alone. And anybody who puts a steel needle to my Galli-Curcis has to stand in the corner in a starched collar and button shoes for two days. It's a rule of the house.

But what about playing LP reissues of old recordings? Outside of liner notes and cover art, you're deprived of the clues that put you into the period for listening, so to speak. That can compromise enjoyment. Years ago, before I even knew that Schipa had recorded for Pathe, I bought a Scala LP made entirely from his Pathes. The performances were marvelous. I hadn't suspected him capable of Cavaradossi, and here he was, singing (opposite an indifferent Tosca) with all the fire and force of a di Stefano at his best. Even so, I found the raucous surface noise hard to take. Schipa's HMVs and Victors, while representing a much lighter and less velvety voice, were sonically far superior.

Now that I own and can play some of the Pathe originals, I understand. And perhaps, if Scala had given more information about the originals on its LP issue, I would have understood earlier. Without that understanding the sonics of the dub keep getting in the way of enjoyment.

Some LP dubs (particularly the older ones) are so filtered to get rid of surface noise that they make enjoyment even more difficult (for me, anyway). But this, too, is a matter of preconditioning. When you know how good the originals might sound if you could play them yourself, you can lose patience with the dub; if you don't, the dub may simply sound "old" and mercifully free of the surface noise that would be as intrusive to your listening as the want of brilliance is to mine. For whose ears is the record company to produce its LPs?

In some cases, for just about anybody's. If the LP company is also the legatee of the original masters (and EMI has a vast store from HMV and its cognates: European Columbia, Parlophone, Odeon, Fonotipia, Electrola, Pathe, Zonophone and heaven knows what else), it can make new pressings in vinyl (to bypass both record wear and shellac surface noise), copy them on tape with appropriate equalization for the best possible sound, edit out any clicks resulting from scratches or other defects in the masters and come out with an LP whose sonic quality is far beyond the abilitites of companies that, like Scala, must work from old pressings borrowed or bought from existing collections. And if you search the reissues catalogues, you'll find many examples of recordings which date from the 78 era but which received their first regular commercial issue on LP, thanks to some energetic scavenger in the vaults of EMI or RCA or Columbia or Polydor.

But you must still know what you're listening to in order to appreciate it. Why, for example, did these recordings go unissued until now? Some acoustic recordings from around 1925 languished solely because the electrical process overtook the industry before the discs could be marketed, and the company realized that the disc would have to be done over by the new (but not necessarily better, as witness *la* Sanchioni) process if it were to sell. Sometimes, the disc just wasn't good enough. (Some of Galli-Curci's later ones, made after a goiter operation had left her with impaired control over the pitch of high notes, were issued in spite of her lapses, while the buying public was mercifully spared some others.) Still others (one Galli-Curci duet with de Luca is a good example) were considered unfit to issue because they wouldn't reproduce well on contemporary equipment, though, today, they are considered gems.

The point is that trying to listen to old records without prior orientation is as difficult as trying to read an old newspaper without knowing when or where it was published. Those who made the recording, just like those who edited the newspaper, made many assumptions — often unconscious ones — about the context in which the product would be understood and the background of experience and habit that the listener or reader would bring to the understanding. Ultimately, we can no more hear early recordings as they were heard when they were new than we can become concerned over a reported rise in trolley fare from three cents to a nickel. Expressions of protest over the traction company's action bring only wan smiles today. So do Cal Stewart's "Uncle Josh" monologues on Edison Diamond Discs, though they sold in the millions in their day.

Yet, in a sense, we can hear more in these faded remnants than our grandparents could. We find in them the roots of our own way of hearing and of living. Where they are tawdry to our ears, we know what we have gained; where they are beyond our powers to recreate today, we know what we have lost. They are echos that will never altogether die, but they will never altogether bring back the sounds that caused them.

In response to the needs of the recording and broadcast industries, Stanton creates the new calibration standard ....the 681 TRIPLE-E....

A definite need arose.

The recording industry has been cutting discs with higher accuracy to achieve greater definition and sound quality.

Naturally, the engineers turned to Stanton for a cartridge of excellence to serve as a primary calibration standard in recording system check-outs.

The result is a *new* calibration standard, the Stanton 681 TRIPLE-E. Perhaps, with this cartridge, the outer limits of excellence in stereo sound reproduction has been reached.

The Stanton 681 TRIPLE-E offers improved tracking at all frequencies. It achieves perfectly flat frequency response to beyond 20 kHz. It features a dramatically reduced tip mass. Actually, its new ultra miniaturized stylus assembly represents an important advance in stereo cartridge design and construction, with substantially less mass than its predecessor. And this stylus assembly possesses even greater durability than had been previously thought possible to achieve.

The Stanton 681 TRIPLE-E features a new design of both cartridge body and stylus; it has been created for those for whom the best is none too good.

Each 681 TRIPLE-E is guaranteed to meet its specifications within exacting limits, and each one boasts the most meaningful warranty possible: an individual calibration test result is packed with each unit.

STANTON

For further information write Stanton Magnetics, Inc., Terminal Drive, Plainview, N.Y. 11803.

Why you should buy the Nikko 5050 stereo receiver.

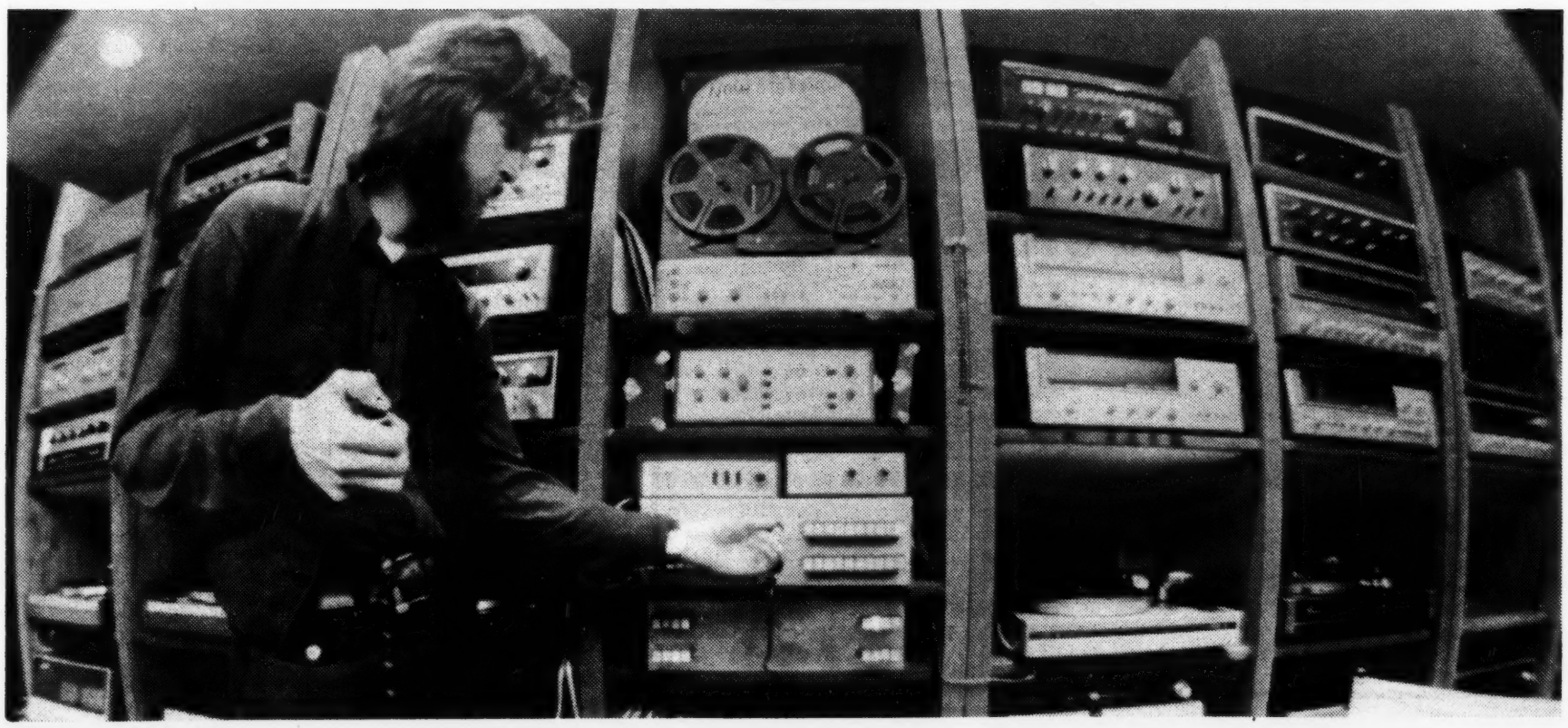
In the very competitive $350 price range, one stereo receiver stands out from all the rest—the Nikko 5050. No other stereo receiver of comparable price can match the Nikko's combination of ample power, great FM reception, handsome appearance, versatile control facilities and supreme reliability.

The Nikko 5050's direct-coupled, pure complementary OCL power amplifier provides 18 watts minimum RMS per channel, into 8 ohms from 20 to 20,000 Hz with only 0.8% total harmonic distortion. Dual-gated FET's in the FM section result in 2.1 uV (IHF) FM sensitivity with an excellent signal-to-noise-ratio of 60 dB. Control facilities include front panel connections for a second tape deck and a pre-amp/power amp cutout on the rear panel that allows connection of equalizers, 4-channel decoders and other accessories. The Nikko 5050 is one receiver that will *never* become obsolete.

Why you should buy it at Tech Hifi.

Tech Hifi is the largest Nikko dealer in New England. We sell more Nikko receivers, amps, and tuners in one week than some authorized dealers sell in a year. So we can give you the lowest prices on Nikko products, especially when you buy them as part of a whole system. And even though the Nikko 5050's advanced solid-state circuitry provides unsurpassed reliability, it's nice to know that if anything *does* go wrong, Tech Hifi can fix it in our own Nikko-authorized Service Center (we offer our own three-year labor guarantee in addition to the manufacturer's guarantee). Other dealers would have to ship it hundreds of miles for repairs.

Come, hear. tech hifi



Trends

Continued from page 6

nois on the basis of psychoacoustic studies of the reproduction of sound fields. Its placement of sound images around the listener is reported to be more accurate than that of the present systems, and it was preferred in a recent BBC engineering evaluation. It is being manufactured (with the system name changed to UD-4) by Nippon Columbia, who probably would market it in the U.S. under the "Denon" brand name, but no large-scale marketing plans have been revealed.

The second new four-channel method, the NDRC Ambisonic system developed in England, can recreate a sound field not only in a circle around the listener but also up and down, providing a true three-dimensional ambience which none of the existing systems can match. But this system is unlikely to be available commercially in the near future. The early introduction and aggressive marketing of the SQ, QS and CD-4 systems have largely pre-empted the market, and they will serve as an effective impediment to the commercial viability of other systems for the next few years. So you can buy one of the new logic-aided SQ or QS decoders without fear that it may rapidly become obsolete.

Time Delay

A few months ago, I predicted the imminent availability of time-delay systems for recreating concert hall acoustics in your 15-foot listening room. That is another forecast which was too optimistic. There will be a slight delay in the appearance of time delay. Matsushita had announced the successful development of a bucket-brigade IC (integrated circuit) which would have served nicely as the core of a time-delay box, but apparently, Matsushita's front-office people spoke before their engineers were ready, as the ICs did not appear on schedule. Nevertheless, the idea of time delay is catching on, and various experimental bucket-brigade circuits for time delay are being worked on. In the Boston area alone, I know of three laboratories that have independently developed prototype time-delay systems and are awaiting the availability of the better ICs needed to obtain a satisfyingly long time delay with low noise and distortion. A wide-range low-noise time-delay system may not be right around the corner, but it is coming.

Dolby FM

Four-channel is not the only area in audio where much-ballyhooed predictions of rapid growth have proved to be overly optimistic. Last spring, the FCC approved a method of combining Dolby-B encoding with reduced "pre-emphasis" (the treble boost applied in broadcasting). The advantages of this scheme were so substantial and its apparent deficiencies so slight that everyone expected to see rapid conversion to Dolby by every FM station with pretensions to quality. The method offers each FM station an effective doubling of its broadcast coverage area (thus, a larger potential audience) at no increase in actual transmitted power. For audiophiles it offers noise reduction, reduced distortion and elimination of the compression that muddies much broadcast sound. And for listeners to ordinary table radios, the Dolby encoding provides a welcome brightening of the sound at low levels.

In anticipation of widespread adoption of Dolby FM, manufacturers are rapidly making appropriate equipment available. Switchcraft has produced a pre-emphasis compensator for use with a conventional Dolby decoder, some tuners and receivers have already appeared with built-in FM Dolby decoding and later this year, many more will appear — some with low price tags.

The fly in the ointment is the local FM stations. In New York, Washington and other major cities, FM stations started converting to Dolby operation shortly after the FCC authorized it last year. Dolby FM has been growing especially fast in the Midwest, hardly the center of high culture. But in Boston FM stations have been very slow to adopt Dolby.

The engineering management of WGBH doesn't want to broadcast with Dolby encoding as long as most listeners lack decoders (despite the fact that trials elsewhere have indicated that the simultaneous change in pre-emphasis proves satisfactory for most listeners). WCRB actually has a Dolby encoder but is reluctant to use it because of concerns about possible incompatibility for listeners in mono as well as stereo. Similarly, WWEL is experimenting with Dolby but has not decided to go ahead with it on a full-time basis. WBUR hopes to adopt Dolby FM as part of its move to a new transmitter, but the bureaucrats at the FCC have been slow to process the application for a construction permit, and it will be another few months at least before WBUR can put Dolby on the air.

There is currently only one Boston-area station using Dolby. WVBF (105.7 MHz) is broadcasting a Dolby-encoded signal full-time and finds that the reduced pre-emphasis has enabled them to modify their peak-limiters for less treble roll-off, so that their signal is clearer and brighter than before.

What Else Is Happening?

Among "conventional" products there are some definite trends worth noting:

Phono pickups. The introduction last year of new disc cutters capable of engraving extremely high-level modulations at high frequencies has been accompanied by corresponding improvements in the ability of phono cartridges to track such groove modulations. High-frequency tracking depends on the effective tip mass of the pickup. While one milligram was considered a good value a few years ago, 1974's best cartridges had tip masses of about 0.5 mg, and it seemed unlikely that further substantial reductions would be possible in the near future. Astonishingly, one or two manufacturers have now introduced cartridges whose pp masses are said to be barely over 0.2 mg. These pickups bear price tags of $100-$150, but now that engineers have learned how to make such low tip masses practical, we can expect that the coming year will bring less expensive pickups with similarly outstanding high-frequency tracking.

Tonearms. Phono pickups keep getting lower in tip mass and higher in compliance, but these improvements have not been accompanied by improvements in tonearms. Consequently, some of today's best pickups may give *poorer* performance in your fancy tonearm than a less advanced cartridge would. Some of the most respected and heavily advertised tonearms today will not elicit optimum performance from the top-of-the-line pickups. Recent articles in the monthly journal of the Boston Audio Society have indicated that the performance of most tonearms can be substantially improved by the addition of "viscous damping" — the damping material (usually Andy Granatelli's STP) eliminates the high-Q subsonic resonant peak which occurs in all cartridge/tonearm combinations. Controlling this inaudible resonance improves stereo imagery, minimizes preamp overload, reduces acoustic feedback and makes warped records much more playable. Of course, the tonearm manufacturers cannot be expected to adopt viscous damping overnight, but there will probably be a gradual trend in that direction.

Turntables. Fifteen years ago, no self-respecting audiophile would use a changer; only single-play turntables were considered acceptable. During the 1960s many very good changers (now called "automatic turntables") were produced and they took over the market; only a few single-play units survived, mostly in the luxury price class. Now, the dominant trend for 1975 is the return of the single-play table (often, with a semi-automatic arm), especially in the $150 price class, which is becoming crowded with good machines. Unfortunately, at this and higher prices, the largest share of engineering attention is being given to fancy ways of making the platter go around with negligible rumble and flutter. The fact is that for 15 years there have been under-$100 turntables with essentially perfect platter-rotating mechanisms; what needs work is the tonearm, not the drive system. But you won't see that fact reflected in turntable ads this year.

Loudspeakers. Despite a lot of rhetoric about novel technologies in speakers, it remains true that the single parameter that (more than everything else put together) determines how a speaker sounds is its acoustic output vs. frequency curve. And the most impressive trend is that loudspeakers really are getting better. A decade ago, there were a few excellent speakers, a few good ones and a flock of lousy ones. But good speakers have become so widely available that they have driven the bad speakers off the market. Today, there are a few excellent ones, a great many good ones and only a few really bad ones.

In addition to a real improvement in quality, there is also a definite trend in the overall tonal balance of loudspeakers toward a brighter sound. As the distortion and noise content of recordings decreases, it becomes possible to listen to brighter speakers without irritation. Even AR, the traditional bastion of the downward-sloping high end, is producing speakers whose tonal balance can be set nearly flat with the crossover controls.

The acoustics of the listening room are still the most important and most ignored determinant of the sound you hear, and too few loudspeaker manufacturers are paying any attention to how the listening room alters the sound of their loudspeakers. Allison Acoustics, whose long-awaited speakers are now in production, has demonstrated how a speaker's interaction with the room can be improved, and it remains to be seen whether other speaker designers will follow.

The Speaker That Leveled L.A.

Hear the sounds of a city collapsing! Feel the earth shake beneath your feet! It's all in the spectacular new film EARTHQUAKE, and it's all made possible by sound waves so deep and powerful that they work more on your body than on your ears. The film people call this incredible new phenomenon "Sensurround",™ but we have our own name for it—Cerwin-Vega. For more information, plus a full-color T-shirt of "The Speaker that Leveled L.A." send $2.50 plus 50¢ for postage & handling to Cerwin-Vega, Dept. E, 6945 Tujunga Ave., North Hollywood, CA 91605. Be sure to state your size (S,M,L,XL) and your Zip code.

Cerwin-Vega

Size: ☐ S ☐ M ☐ L ☐ XL

Name_____

Address_____

City_____ State_____ Zip_____

Don't miss the exciting EARTHQUAKE sound track on MCA records & tapes.

Chamber

Continued from page 32

line graph showing any change in broadcast volume levels along a 20-20,000 Hz continuum.

Testing the on-axis response of a loudspeaker is preferable to the alternative, which is to measure the overall broadcast sound in a reverberation chamber, an equally dreadful room designed to produce the opposite effect from an anechoic chamber. It's like an empty gymnasium. Every sound is reflected over and over again. In a way, testing with filtered white noise in a reverberation room (as opposed to with pure tones in an anechoic chamber) is a closer simulation of a speaker's performance in your living room, but the results tell you less otherwise about the real quality of a speaker unit.

When you walk into an anechoic chamber you'd swear you were going deaf. Background sounds — the traffic, the air conditioning, the neighbor's radio, barking dogs — all the sonic accompaniment of our everyday environment disappears, and since there's nothing to listen to, you can't hear anything. When you talk, you hear a thin, flat version of your own voice. It's like singing into a pillow. If someone else talks, you can hear them, but the silence, paradoxically, is louder than the voice you hear. The only way to lessen this effect is to face another person when you talk so that the voices can bounce between the two bodies.

If some nasty person abandoned you, bound and gagged, in an anechoic chamber and closed the door behind him, you would quite possibly go mad. After sitting still and mute for about 30 minutes, you would begin to hear things again — things like your heart pounding or your blood pumping through your veins or your saliva gurgling down your throat or your nervous system whining. If you moved at all, you would be bombasted with the sound of your muscles creaking and your joints snapping. People have experienced this, but most of us pack it in and leave before our half hour is up. An anechoic chamber is a good place to keep your monster and an even better place to test a speaker, but you wouldn't want to live there.

The Rectilinear 5: end of the myth of rock speakers vs. classical speakers.

The new Rectilinear 5 is capable of playing very, very loud. Rock-festival loud. Even with a medium-powered amplifier.

At the same time, it's uncannily accurate. It sounds sweet, unstrained and just plain lifelike at all volume levels.

The temptation is great, therefore, to one-up that prestigious manufacturer who some time ago announced "The first *accurate* speaker for rock music."

But we refuse to perpetuate that mythology. It's perfectly obvious that the Rectilinear 5 reproduces classical music just as accurately as rock. We could never see how a voice coil or a magnet would know the difference between Jimi Hendrix and Gustav Mahler.

So we'd rather use this opportunity to set things straight once and for all.

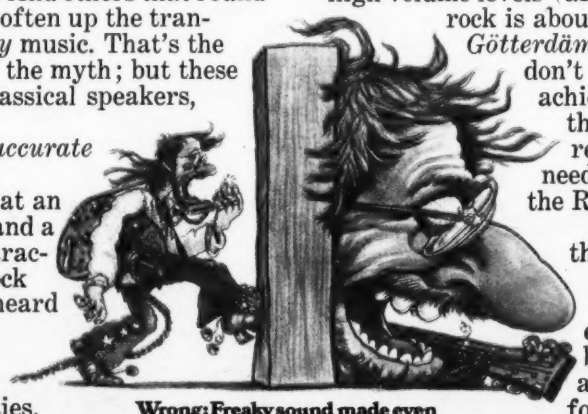
Thus:

There's no such thing as a rock speaker *or* a classical speaker. Any more than there's a late-show TV set or a football-game TV set.

There are, however, speakers that impose a hard, sizzling treble and a huge bass on *any* music. And others that round off the edges and soften up the transient details of *any* music. That's the probable origin of the myth; but these aren't rock and classical speakers, respectively.

They're *inaccurate* speakers.

It's true that an aggressive treble and a heavy bass are characteristic of most rock music, even when heard live. It's also true that some record producers exaggerate these qualities, sometimes to a freakish degree, in their final mix of the recorded sound.



Wrong: Freaky sound made even freakier by the speaker.

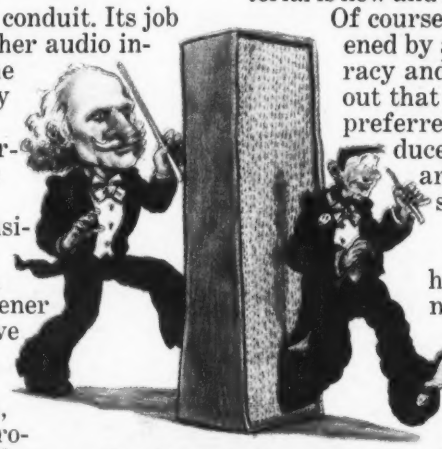
But that doesn't mean the speaker can be allowed to add its own exaggerations on top of the others.

A loudspeaker is a conduit. Its job is to convey musical or other audio information unaltered. If the producer wants to monkey around with the natural sound that originally entered the microphones, that's his creative privilege. He'll be judged by the musical end results. But if the speaker becomes creative, that's bad design. (The listener who can't resist the creative urge can always use his tone controls.)

By the same token, if some classical record producers prefer a warm, pillowy, edgeless string sound, that doesn't mean your speakers should impart those same qualities to cymbals, triangles or high trumpets. (Stravinsky's transients can be as hard as rock.)

And if you like to listen at very high volume levels (after all, that's what rock is about—but so is *Die Götterdämmerung*), you still don't need a speaker that achieves high efficiency through spurious resonances. What you need is something like the Rectilinear 5.

Everything in this remarkably original design was conceived to end the trade-off between efficiency and accuracy. The four drivers are made to an entirely new set of specifications. The filter network that feeds the drivers is totally unlike the traditional crossover network. Even the cabinet material is new and different.



Equally wrong: Classical sound made vague and spineless by the speaker.

Of course, those who feel threatened by all this fuss about accuracy and naturalness will point out that the monitor speakers preferred by engineers and producers in recording studios are usually of the zippy, super-aggressive variety.

That's perfectly true, but the reason happens to be strictly nonmusical.

"I use the XYZ speaker only as a tool," a top producer explained to us. "I wouldn't have it in my house. It really blasts at you when you crank up the volume, so that any little glitch on the tape hits you over the head. After eight hours in the studio, that's what it takes to get your attention. I know how to deal with those unpleasant highs; they're in the speaker, not on my tape."

It's easy enough to find out for yourself. Any reputable dealer will let you hear the Rectilinear 5 side by side with a "rock" or "monitor-type" speaker. Adjust each speaker by ear to the *same* high volume level, making sure the amplifiers are of good quality. Then listen. To rock *or* classical.

Then and there, the myth will crumble.

Rectilinear 5 Contemporary Laboratory Series bookshelf/floor speaker system, $299.00 Rectilinear Dispersion Base (patent pending) optional.

RECTILINEAR®

Rectilinear Research Corp.
107 Bruckner Blvd., Bronx, N.Y. 10454
Canada: H. Roy Gray Limited, Ontario

A & W Electronics
491 Riverside Ave., Medford
1001 Providence Hwy., Norwood
2 Franklin St., Lawrence

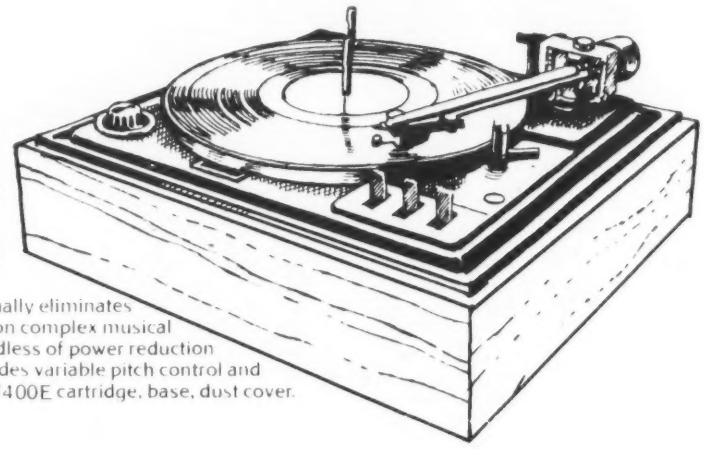
Auclair
566 Cass Ave.
Woonsocket, R.I.

You-Do-It Electronics
40 Franklin St., Needham

tech hifi

Massachusetts 240A Newbury St, 870 Commonwealth Ave Boston 38 Boylston St, 182 Massachusetts Ave, Cambridge, Route 9, Framingham Route 1, Dedham 352 Main St, Stoneham 667 Main St, Waltham 279 Main St, Worcester, 48 Teed Dr, Randolph 186 Main St, Northampton 253 Triangle St, Amherst **Connecticut** Caldor Shopping Center, West Main St, Avon **New Hampshire** 2 Worth Plaza, Portsmouth Main St, Hanover Nashua Mall Extension, Nashua **Vermont** 150 Church St, Burlington 21 Main St, North Bennington **Maine** 342 Fore Street, Portland **Rhode Island** 165 Angell Street Providence 1989 Post Road, Route 1, Warwick

The First Factory Authorized Garrard Sale



Save $87.85 on the Garrard Model Zero 100C Package

$199.95 If purchased separately: $287.80

Features Garrard's famous Zero Tracking Error Tonearm that virtually eliminates tracking error in record grooves, produces less distortion, more articulation on complex musical passages. Precision hysteresis-synchronous motor assures constant speed regardless of power reduction or fluctuation. Plays up to 6 records at 33⅓, 45 RPM. Includes variable pitch control and built-in strobe for instant speed check. Plus Pickering XV-15/400E cartridge, base, dust cover.

Save $82.85 on the Garrard Model Zero 92 Package

$149.95 If purchased separately: $232.80

The Model Zero 92 boasts every feature of the Zero 100C including Zero Tracking Error Tonearm, but without variable pitch control counter and strobe. Hysteresis-synchronous motor gives constant speed under all conditions. Cueing device and adjustable lever-type anti-skating, too! **Plus** Pickering V-15 Micro IV/ATE cartridge, base, dust cover.

Save $82.85 on the Garrard Model 82 Package

$99.95
If purchased separately: $182.80

For the cost-conscious perfectionist! The high-precision, heavy-duty Synchro-Lab motor insures constant speed; low-mass tonearm tracks your records flawlessly, virtually without distortion. Cueing and anti-skating devices, too. **Plus** Pickering V-15 Micro IV/ATE cartridge, base, dust cover.

Other Garrard Models Comparably Sale Priced

Available at the Following participating Garrard dealers:

DeORSEY RECORD SHOP
Four Maine Locations

K and L SOUND SERVICE
Watertown

LECHMERE SALES
Cambridge
Dedham
Springfield
Danvers

DeMAMBRO HI-FI
Boston

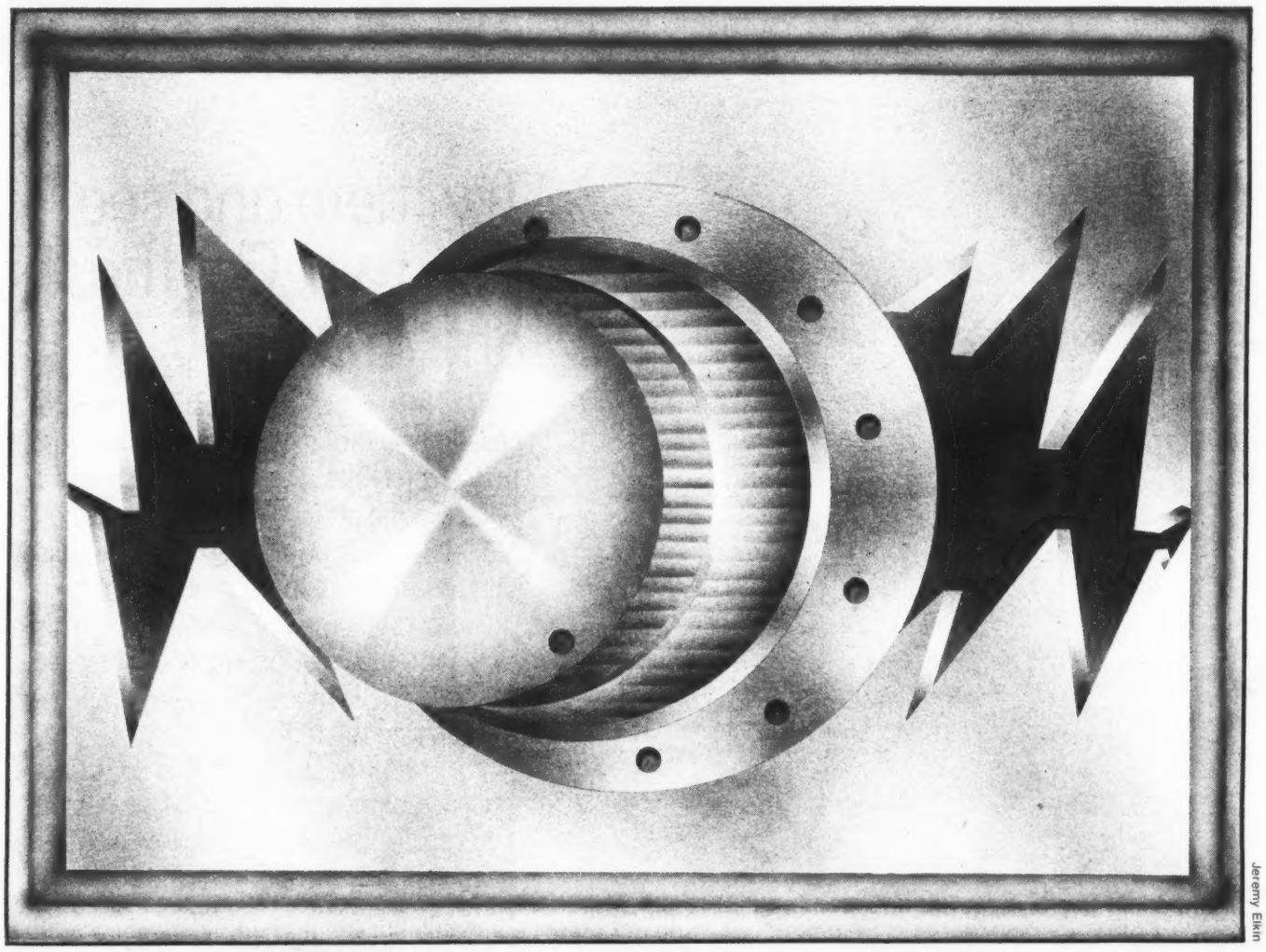
SOUNDSCOPE
All Locations

MINUTEMAN RADIO
Cambridge

NANTUCKET SOUND
Hyannis
North Dartmouth

TECH HI-FI
All Locations

Sound Advice



Jeremy Elkin

How Much Power?

By Peter W. Mitchell

One of the more frequently asked questions in high fidelity is "How much power do I need?" For some listeners an amplifier with several hundred watts per channel actually may be inadequate; for others a 20-watt system is unnecessarily powerful. More sophisticated listeners, knowing that it depends on the speaker, will instead ask "How much power do I need to drive these speakers?" Either way it is a frustrating question, because there is no good way to answer it. That being the case, I will not answer it here. Rather, I will indicate why no one can give you a good answer, and perhaps in the process you will learn how to provide your own figure.

The first thing to remember is that the ear's sense of loudness is related approximately logarithmically to the acoustic power level. This means that a barely perceptible change in loudness (a one decibel change) requires a 25 percent change in power, and a moderately small change in loudness (a 3 db increase) requires double the power. Since such small differences in loudness involve relatively large changes in power, your power "need" can be stated only approximately. If you hear a difference between a 70-watt and a 60-watt amplifier, the distinction has to be one of quality, not power.

"A barely perceptible change in loudness requires a 25 percent change in power, and a moderately small change in loudness requires double the power. Therefore, your power 'need' can be stated only approximately. If you hear a difference between a 70- and a 60-watt amplifier, the distinction has to be one of quality, not power."

With that in mind, the power you need depends on the following factors:

The maximum sustained sound-pressure level (SPL) which you "like" in reproduced music. People's preferences in loudness vary. Some listeners are uncomfortable when the SPL exceeds 85 decibels, others demand 105 db levels to be satisfied. For comparison, maximum sustained concert-hall sound levels are, typically, 85-90 db in Mozart symphonies, about 95 db in the loudest parts of a Beethoven or Brahms symphony, and 100-105 db in the biggest climaxes of Wagner and Mahler. Sound levels at a discotheque or rock concert may reach 115 db.

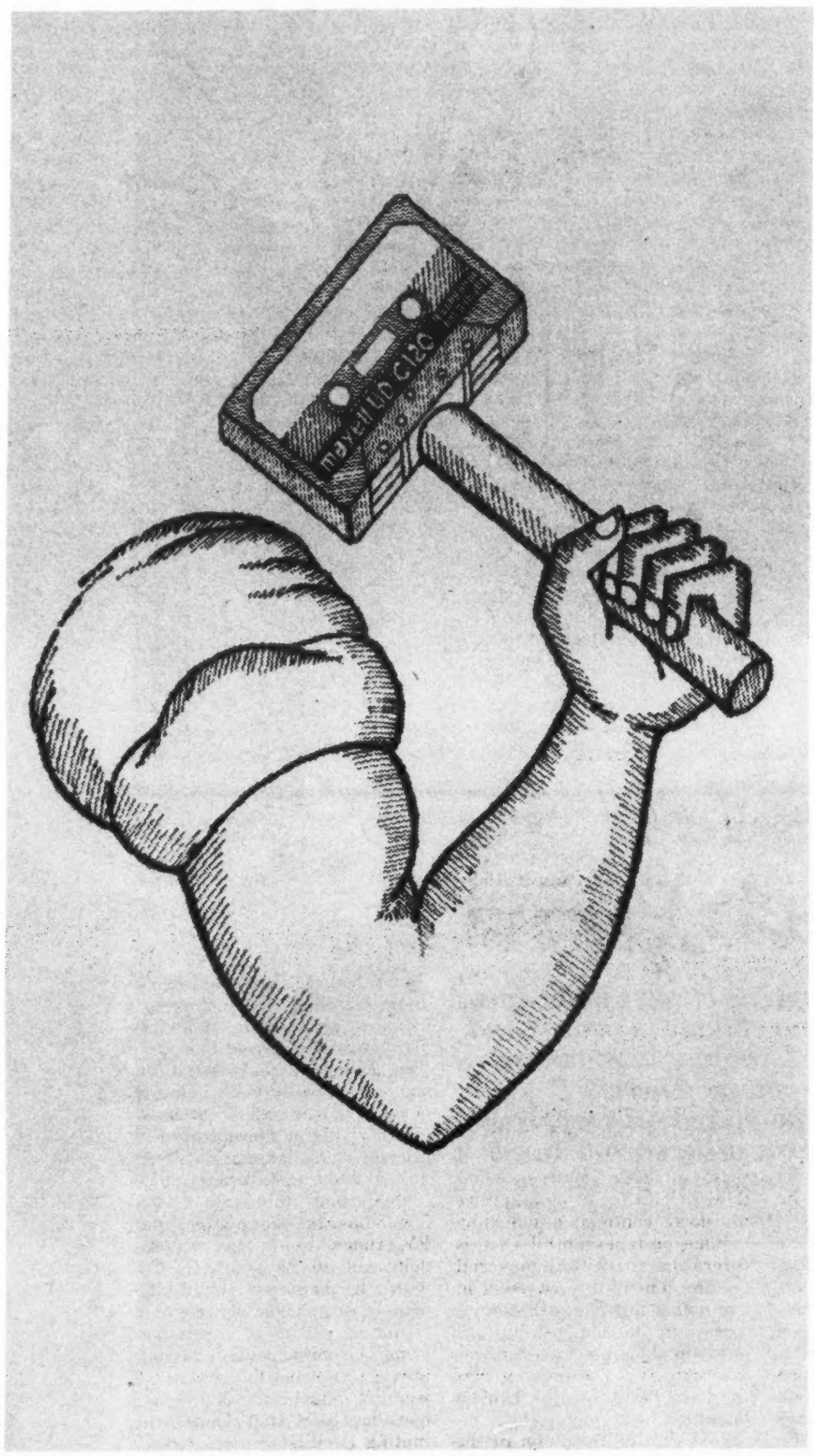
The maximum SPL you like is partly a matter of what you're accustomed to. It depends on the kind of music you listen to. It also depends on how much the dynamic range of the music has been compressed for recording or broadcast. If you play the loudest part of a compressed recording at a lifelike level, the soft parts will be unnaturally loud and the whole effect becomes oppressive, so you will tend to turn it down to restore the average loudness to a comfortable, lifelike level. But if you use a dynamic-range expander or play only wide-range material, you may set the average level to sound right and then find brief climaxes to be very loud, requiring lots of power.

Another factor that affects your preferred maximum SPL is the surrounding noise level. If your stereo system must compete with noise from the refrigerator, air-conditioner blower, and street traffic, you will probably play it louder than the person whose music blooms in a relatively silent environment. The time of day also matters: a level that sounds loud in the morning may seem only moderately so in the evening. All in all, the individual listener's preferred maximum sustained SPL is the most variable determinant of amplifier power. To answer the question really, you could spend $50 for an SPL-meter and go around measuring the sound levels at concerts, dealer showrooms, and friends' stereo systems until you learn what maximum SPLs sound "right" to you.

2) The efficiency of your loudspeakers. In the average loudspeaker, 99 percent of the incoming amplifier power ultimately disappears as heat; only about one percent is converted to sound. In some speakers the conversion efficiency is as low as 0.5 percent, in others it is over five percent. Speaker efficiency is the second greatest variable affecting your power requirement. A while back I tabulated the approximate amplifier power required to produce a sound pressure level of 100 db in an average listening room for about 60 different loudspeakers. The average value is about 25 watts. But if you are buying a system you may find yourself choosing between two of the most popular $70 speakers, one of which needs about 16 watts and the other about 80 watts to produce 100 db. The popularity of many low-efficiency speakers (like the latter) depends on the fact that many listeners are quite content with a maximum sound level of

Continued on page 30

OUR 120's WORK



Try them and see. Buy two. Get the third one, free!

The trouble with most 120 minute cassettes is that they break. Or they jam. Or they stretch into distorted uselessness.

On the other hand, you can use a Maxell Ultra Dynamic or Low Noise cassette and forget about these problems.

We combine pre-stretched "tensilized" tape with the most precisely engineered cassette shells made. You get reliable performance, and the highest quality sound.

The Ultra Dynamic UDC-120 plays back every tone the very best equipment can record. The Maxell Low Noise cassette shell is just as strong. It sounds almost as good and it costs less.

If any Maxell 120 cassette fails, we'll replace it. But we don't think we'll have to.

Our Buy Two, Get Three offer is available from March 15 to April 30, 1975.

Maxell Corporation of America, Moonachie, New Jersey 07074. Also available in Canada.

maxell®

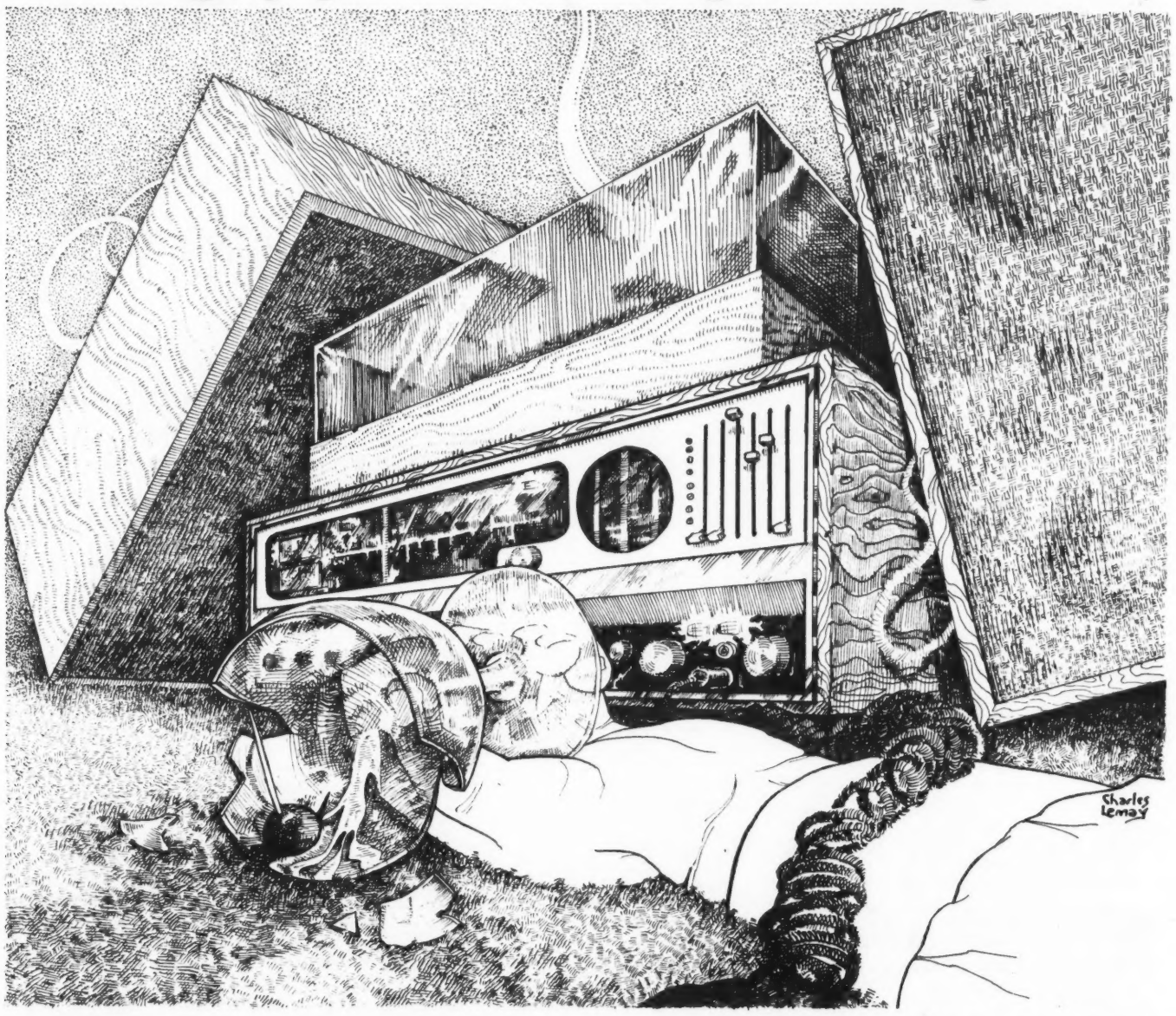
For professional recordings at home.

AR-KAY ELECTRONICS
Watertown
ATLANTIS SOUND
261 Thayer St., Providence
38 Brattle St., Cambridge
536 Commonwealth Ave., Boston
811 Boylston St., Boston
248 Worcester Rd., Framingham
10 Sylvan St., Peabody
So. Shore Plaza, Braintree
31 Broadway, New Haven, CT.
AUDIONICS
Providence, R.I.

BI-RITE
Manchester, N.H.
CON SONICS
Danvers
COOP
M.I.T.
Harvard Square
COPLEY CAMERA
Boston
DELTA HI-FI
Bristol, CT.
DeMAMBRO
Brighton

K&L SOUND
Watertown
MALCO
Lawrence
MANCHESTER MUSIC
Manchester, N.H.
MINUTE MAN
Cambridge
NANTUCKET SOUND
Hyannis
North Dartmouth
OLDE COLONY STEREO
(Sales & Service)
Quincy
Cohasset
Hanover
SOUNDSMITH
Portsmouth, N.H.
SOUNDTRACK
Woonsocket, R.I.
STEREO PLACES
Providence, R.I.
STEREO SOUND
TECH HI-FI
Boston
Cambridge
Dedham
Framingham
Northhampton
Waltham
Stoneham
Worcester
Providence, R.I.
Dover, N.H.
Nashua, N.H.
Amherst
Warwick, R.I.
SUFFOLK AUDIO
Cambridge, Mass.
WALTHAM CAMERA
Waltham

Blazing Speakers: Living (?) With a Super Amp



By Jim Brinton

You have decided how much amplifier power you need, and the answer is lots. So you tool down to the local hi-fi store and come back with a huge power amplifier. Do you realize, however, that you have bought not only what's called "listening pleasure" but also the ability to destroy loudspeakers at the touch of a button — or even the capacity for unintentionally dispatching yourself?

One maker of these giant amplifiers advertised his product briefly as "the arc-welder's special." That's not a name to inspire customer confidence, and the ad was quickly withdrawn, but there was some truth in the description.

Realize that the power supplies in these giant amps are huge; the transformers may weigh upwards of 50 pounds, and the filter and storage capacitors in the chassis can store enough energy to kill an elephant. Maybe a first rule should be to leave what's inside the chassis alone.

Not that these amps are designed to kill; nothing could be farther from the truth, and most units are quite safe. They tend to be safer, in fact, than some other smaller units with less power (which thus provided less of an incentive for engineered-in safety). Still, even if your body isn't in great danger, these amps can inflict considerable damage on your loudspeaker, especially if it's of the efficient "West coast" variety (*i.e.* JBL). Inefficient "Cambridge sound" loudspeakers also can be smithereened fast, though, so it pays to take precautions. After all, you are paying a lot of money for enjoyment of music, not for the doubtful privilege of watching your woofers burst through the grill cloth.

Step one: ground the beast. If your amp has a three-prong plug, make sure that your local three-hole outlet really is grounded itself. If you can't do this yourself, ask a friend with some electrical knowledge; it's a simple task that takes no time. If you can't get even this measure of cooperation from your fellow person, run a heavy lamp cord from a convenient screw or bolt on the chassis to a water pipe — not a gas pipe, a water pipe. This will not only pay possible dividends in reduced noise (hum, for example) but also will drain off any stray electricity, the presence of which might come as a shocking revelation. If this seems like safety overkill, well, it's better not to be killed yourself, or welded to something.

Second — and *before* you even disconnect your old amp — check your system for some of these fatal (to your speakers) flaws. Check your preamplifier for noisy controls; a crackling volume or tone control that is tolerable in a low-powered system can destroy tweeters in one with a higher-powered amp. The same is true of push-buttons or knobs that "pop" when pressed. As a general rule, your preamp should be dead silent in operation.

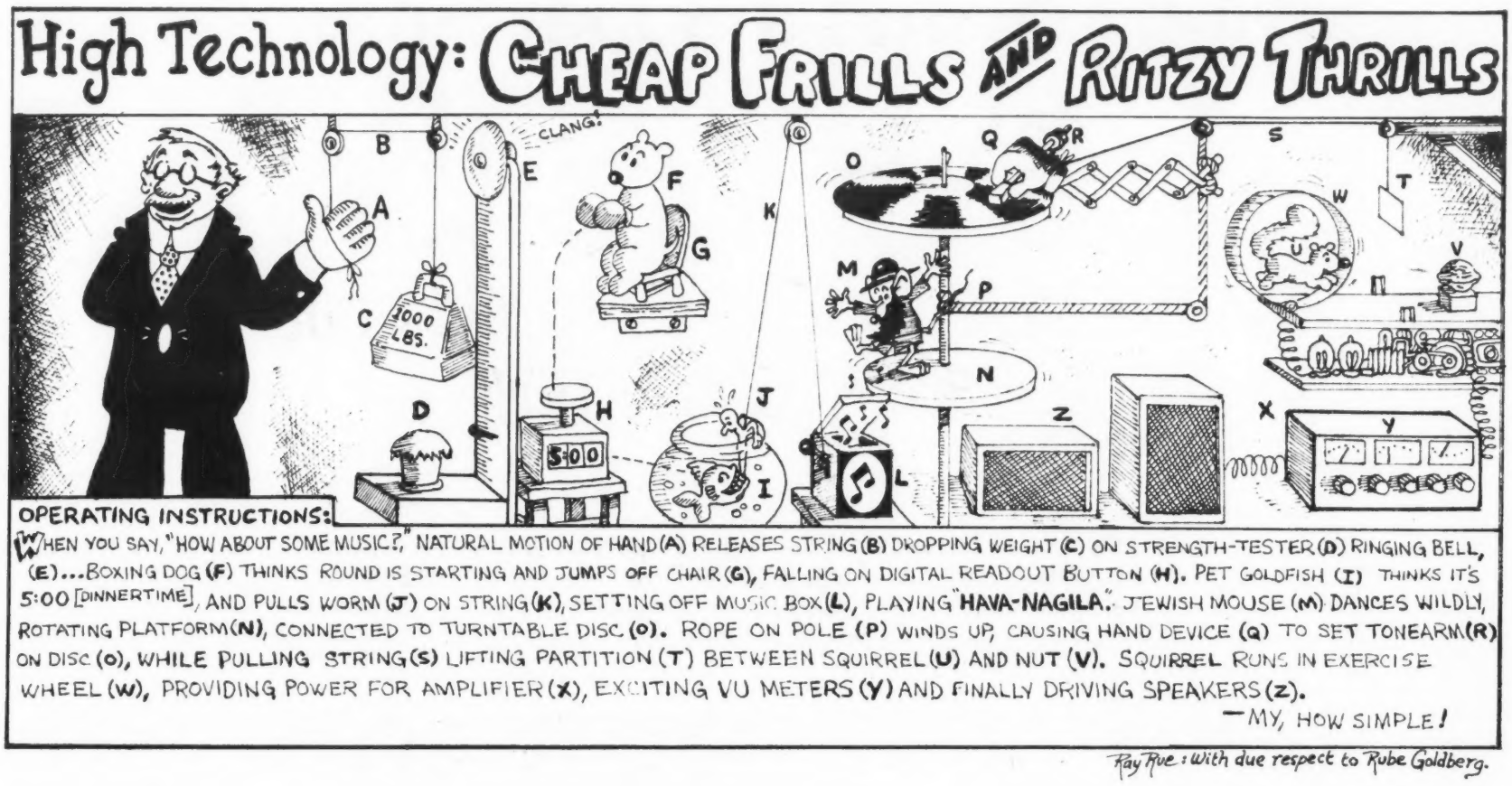
Just turning things on in the wrong order can occasionally slay drivers. As a rule, turn the power amp on separately, and turn it on last. Reverse the proces when turning the system off. As other components turn on and off, they can send powerful thumps at very low frequencies along the line to your power amp, which will, in its turn, boost these to, maybe, kilowatt pulses. Your woofer might withstand a few of these but, sooner or later, it will spill its guts out on the living-room floor. So establish a simple on-off operating procedure and stick to it.

One unsuspected source of low-frequency transients is your FM tuner. Some muting circuits cut in between stations with a horrendous thump, down near DC (O Hz). Having lost a couple of woofers to a friend's tuner, I commend care in this area to your attention. And while you're looking for "thumpers," consider also that there are muting circuits in some record changers or automatic turntables; check these, too.

How? By taking your tuner or record player to a service shop if nothing else. If you can't do that, have no test gear, and really have your back to the wall ("I wanna hear it; I wanna hear it . . ."), tune between stations both slowly and quickly or actuate your record player's muting circuit, all the while watching your woofer's cone move (if the grill isn't removable, shine a flashlight through it into the speaker). Naturally, you are using your old amp while doing this, or at worst, operating your new amp with the volume

Continued on page 28

"Step one: ground the beast. If your amp has a three-prong plug, make sure that your local three-hole outlet really is grounded itself . . . . This will not only pay possible dividends in reduced noise (hum, for example), but also will drain off any stray electricity, the presence of which might come as a shocking revelation."


High Technology: CHEAP FRILLS AND RITZY THRILLS
CLANG!
1000 LBS.
5:00
OPERATING INSTRUCTIONS:
WHEN YOU SAY, "HOW ABOUT SOME MUSIC?," NATURAL MOTION OF HAND (A) RELEASES STRING (B) DROPPING WEIGHT (C) ON STRENGTH-TESTER (D) RINGING BELL, (E)...BOXING DOG (F) THINKS ROUND IS STARTING AND JUMPS OFF CHAIR (G), FALLING ON DIGITAL READOUT BUTTON (H). PET GOLDFISH (I) THINKS IT'S 5:00 [DINNERTIME], AND PULLS WORM (J) ON STRING (K), SETTING OFF MUSIC BOX (L), PLAYING "HAVA-NAGILA." JEWISH MOUSE (M) DANCES WILDLY, ROTATING PLATFORM (N), CONNECTED TO TURNTABLE DISC (O). ROPE ON POLE (P) WINDS UP, CAUSING HAND DEVICE (Q) TO SET TONEARM (R) ON DISC (O), WHILE PULLING STRING (S) LIFTING PARTITION (T) BETWEEN SQUIRREL (U) AND NUT (V). SQUIRREL RUNS IN EXERCISE WHEEL (W), PROVIDING POWER FOR AMPLIFIER (X), EXCITING VU METERS (Y) AND FINALLY DRIVING SPEAKERS (Z).
—MY, HOW SIMPLE!
Ray Rue: With due respect to Rube Goldberg.

By Stan Perlmutter

Walking into a high fidelity salon today is a little like entering mission control in Houston, except that the hi-fi equipment looks more sophisticated. The consoles in mission control, after all, were designed only to get men to the moon; hi-fi equipment is designed to "sell you."

Technology as advertising is nothing new to the hi-fi biz, but it keeps reaching higher pitches of schlockmanship each year. This is going to catch up with the market only when consumers get educated to the differences between useful and useless technology. With that in mind, here's a cynical hi-fi buff's guide to frills that're worth is (plus remarks on some that are not):

Useless stuff. Other than (maybe) making you feel better about spending, there are some features to hi-fi equipment that have no real purpose other than to make a product look more sophisticated and more salable. Among these are digital readouts on FM tuners, VU meters on power amplifiers and four- or five-band equalizers on preamps. There are others.

Digital tuner readouts don't do a thing for you. They do increase price, though, often by more than $100. So if you see a tuner with a digital readout, check to see whether you can't find one with a slide-rule dial with the same performance for a couple hundred dollars less. What's really worth paying for in today's tuners are two things: an accurate method of tuning to the exact center of a station's channel (digital readouts are *no* help here, but some very simple meters are) and "phase-locked-loop" (PLL) stereo demodulator circuits for lowest possible distortion and noise.

Despite the rash of high-priced tuners unveiled in the past year, there is a real question whether anybody should spend more than $400 or $500 for a tuner. Some of the $1000-and-up jobs actually are sophisticated and perhaps worth it if you want to feed a local community antenna system or need an FM-station performance monitor. But the average guy should save his money for the simple reason that most FM stations are rotten compared with any good tuner. Buy a tuner for under $500, and spend the difference on stamps. Writing to FM station owners and engineers is a better way of getting better sound.

Don't dismiss the oscilloscopes that come with some tuners in the same way you would digital readouts. If you are self-destructive enough to spend the money that tuners in this class command, buy one with a scope. The TV-like scope can be the best combination of tuning meter, multipath beater and performance monitor available on any tuner. As an added benefit, some tuners' scopes also can be used to monitor the performance of the rest of your hi-fi system.

At the other end of the value scale are meters on power amps. They are useless to all but a few audiophiles and engineers. Those swinging needles really look good, though, especially the ones with the blue-green lights and windshield wiper dials. Turn out the lights and watch — but don't buy, save the extra hundred bucks or so for records.

Built-in equalizers on preamps aren't all that useful either, even though some good preamps have them. The problem is that they have too few bands — five, usually — for room equalization and almost always affect the frequencies *not* wanted to equalize program material. If you want an equalizer, buy a separate one; if you want a preamp, buy a separate one, too. You'll save what the nearly useless equalizer panel would have cost you.

Tape. The bywords in tape today include: ferrite heads, cassette monitoring facilities, simul-synch, "double-play," peak-reading indicators and metal reels.

All other things being equal, buy a machine with old-fashioned metal heads over one with ferrite ones. While ferrite heads won't wear as quickly as metal heads, they won't allow you to put as much signal on the tape either, nor do it as cleanly. Because ferrite heads "saturate" at lower signal levels than metal ones, they leave you less margin for error. While this might be tolerable on open-reel decks where you have less worry about signal-to-noise ratio and peak-recording capabilities in the first place, it can be suicide on a cassette deck.

Monitor heads, now appearing on some of the more costly cassette decks, *are* worth it. One of the toughest things for an open-reel recordist to get used to if he tries to use cassette equipment is the usual lack of monitoring heads; almost all open-reel decks have them, and they allow users to check during recording to see (a) whether anything is, in fact, getting onto the tape, and (b) how good it sounds there. Without a monitor head it is possible to waste a whole cassette — and the equivalent amount of time — because you fail to press some critical button or set levels improperly, overloading and distorting an otherwise good recording. So, monitor heads are handy and useful.

"Digital readouts increase price, often by more than $100. So if you see a tuner with a digital readout, check to see whether you can't find one with a slide-rule dial with the same performance for $200 less."

Simul-synch is and is not useful. Many of the better four-track open-reel decks can be had with simul-synch, but if all you want to do is record in quad, don't bother with it — it is just extra money spent to no purpose. On the other hand, if you like to make recordings one track at a time — say, combining vocal, guitar, synthesizer and other lines one after the other — simul-synch is indispensable.

Double-play decks stop at the end of a reel of tape or a cassette and then play the other side without coaching. This is useful, depending on how lazy you are and on whether the music on the other side of the tape is interesting. With 45 minutes per side, it is possible to listen for an hour and a half without getting up; whether that's worth the dough is up to you.

What would be more useful is the ability to *record* in both directions. There are times in live situations and off-the-air recording when you just don't have time to flip reels, and it would be great to be able to simply press the "reverse record" button. Not much of this equipment is available, though.

Peak-reading indicators are worth all the maker wants to charge you. There are several varieties, from the usual meter-movement types to nifty flashing lights. Each tells you when a particularly loud sound has gone by. Since most recordings are one-time opportunities, it behooves you to get all the music on tape, and since lots of the punch and realism in music is in short peaks far louder than the average level usually displayed on a VU meter, it is possible to set recording levels conservatively — so you think — and still bomb out, simply because the tape can't soak up the extra, unsuspected energy. Peak indicators help a lot in this regard, especially with cassette decks where there is less margin for error than with open-reel machines.

Metal reels? Why buy them (except for the fact that they appear in all the ads)? Because almost all plastic reels are warped, and it's possible to scrape the oxide off the edges of your tape if the edges are badly warped. And when the oxide disapears, so does your recording. These reels cost, but they are worth it.

Then there is the new generation of "super tape" and at least one cassette which claims to shatter glass in its advertising. Just bear in mind that (a) few decks today are capable of using the new super tapes to best advantage, (b) that they cost a good deal more than a lot of good tape now on the market and (c) that they apparently don't offer that much more for the money. As for the glass-breaking cassette, (a) any recording tape will do this if you pick the right glass and the right frequency and play it loud enough, and (b) it took weeks for the company's ad agency to find a glass that would shatter.

Speakers. Before you plunk down your bread for a highly touted "breakthrough box," consider these facts. Ordinary dynamic loudspeakers — and even electrostatics — have reached a high degree of refinement during many years of development. Their principles and peculiarities are well understood, and a good engineer can perform wonders with relatively low-cost designs. Although these "ordinary" loudspeakers are still being improved (what isn't?), they give smooth and spacious sound

Continued on page 6

MARCH IS PIONEER MONTH AT LECHMERE

AND WE'RE KICKING IT OFF WITH THIS PIONEER SOUND PROJECT 300 STEREO SYSTEM

- This unit is authentic high fidelity with all the quality craftsmanship you have come to expect from Pioneer. It has an amplifier combined with a sensitive tuner and is comparable in performance to much more expensive units. And it's equipped with just about all the controls, features, and connection facilities that you'll need.
- Plus a pair of QUADRUS I TWO-WAY SPEAKER SYSTEMS with an 8" woofer and 3" tweeter. In vinyl, walnut-grained enclosures.
- Plus the BSR 2260X AUTOMATIC RECORD CHANGER complete with magnetic cartridge, diamond stylus, tinted dust cover dut cover and handsome walnut-grained base.

BONUS! A FREE ELTON JOHN POSTER WHEN YOU COME IN TO LECHMERE FOR A PIONEER STEREO DEMONSTRATION

IF PURCHASED SEPARATELY 328.66

LECHMERE'S SYSTEM PRICE 239.88

PIONEER PL 10 TURNTABLE

A big performance stereo turntable at this never-before low, low price. Belt-drive with sensitive S-shape tonearm and easy operating controls. Comes with base and dust cover.

LECHMERE'S REG. LOW PRICE 99.95

NOW 69.88

SAVE 30.07

CAMBRIDGE
OPEN 10 A.M. to 10 P.M.
EXCEPT SAT.
9 A.M. to 6 P.M.
DEDHAM • DANVERS
OPEN 10 A.M. to 10P.M.
MON. thru SAT.

LECHMERE

WHERE YOU POCKET THE DIFFERENCE

YOU DON'T HAVE TO SAVE UP TO SAVE USE YOUR LECHMERE CHARGE CARD

Frills

Continued from page 4

that is not only easy to live with, but also usually very reasonable in price.

What is a high technology speaker? The Walsh driver is one, and it's used in the Ohm-F loudspeaker. The problem isn't with the principle, or even with the performance of some of these speakers — some Ohm-Fs sound excellent and are very hard to beat. Their problem lies in uneven quality; some units are less accurate than others, and some buyers may be unhappy if they get one. This happens less often with standard, easily reproduced speaker designs.

On the other hand, there is another speaker using a Walsh tweeter: the Infinity. Its sound is excellent, and the reason may be that its Walsh driver has to deal with only high frequencies, while standard speakers take over at lower frequencies. Maybe the problem with the Ohm lies in trying to make one (relatively new, and as yet, not that refined) driver cover the whole range from bass through treble.

The problems with the Ohm-F's quality control aren't sinister indications of an attempted ripoff. Like every other product, the Ohm has had to go through a period of relatively costly development, and now the company has to make some money in order to stay in business. Thus, they may have been forced by economics to market a product which is not fully developed in terms of performance con-sistency. Some of the problems, therefore, have had to be solved during production.

You can argue the ethics of this — is a company's first duty to stay alive and thus keep its techniques alive, or should it risk bankruptcy to protect the consumer? — but at least realize what you are getting into when you buy one of these systems. For that matter, though, poor judgment keeps makers of poor dynamic loudspeakers in business, so getting stung isn't the sole province of the technology-conscious audiophile; and Ohm F's aren't any less consistent than other esoteric designs; and finally, an unhappy customer always exchange a less-than-perfect unit.

What about "motional feedback" loudspeakers (*a la* Philips) or servo-controlled speakers (*a la* Infinity)? They are really the same principle and, once again, this is stuff that looks new but is old and pretty well understood. The approach reduces distortion, can cut box size (occasionally) and can save some electronics cost, depending on how the system is put together. Again, if it sounds right, buy it.

Power. Super-powered amplifiers are the rage these days, and there are solid reasons for it: amps that handle musical peaks easily play louder and sound a little better. The question is whether they sound better enough to make their prices worthwhile. If you have a pretty educated ear, chances are that they *will* sound better. But if you have a choice, hold back on the wattage and save the $100 or so that they would have cost.

Headphones. High technology in headphones means four-channel and electrostatic headsets. The former isn't worth it, but the latter is.

Even the makers of four-channel phones chuckle a little about them — "they're OK if you read the directions first," says one engineer. "The book says that the sounds in the 'rear channel' drivers come from behind you, and the front sounds from in front, and if you read the directions before firing up the phones for the first time, you'll believe it, too. But after all, you've only got two ears, right?"

Electrostatics are a different story. These costly phones are worth the extra cash. Not only can they bring out musical detail more readily than any other type of transducer — including the several thousand-dollar loudspeaker systems — but they do so with a lack of distortion that is awesome. Koss or Stax electrostatics are widely used by professionals to check for flaws in their own electronic gear, in recording mixes and in other applications where the cleanest sound is a necessity. No technology hype here.

Record players. But the technology in turntables and tonearms *is* hyped. For example, for every arm with damped pivots, there are a dozen record players with far less useful hydraulically damped cuing devices.

There's a lot of other stuff that really makes little difference in the enjoyment you can get out of your records — stroboscopic readouts, electronic speed control, various "drivers" and useless knobs and controls.

The average audiophile does not need either strobes to tell him how fast or slow his table is running or electronic speed control to make sure it is exactly on the mark. This sort of feature is very useful to musicians, studio types and folks with perfect pitch to whom off-speed operation is honestly painful. But if you are just interested in putting on a disc and having the music come out of your system, try to find a (less costly) turntable without such fancy speed control. You could save upwards of $100.

There's also a running battle between proponents of "direct-drive," "belt-drive" and "rim-driven" turntables and changers. To the average guy, this has about as much meaning as the old angels-on-a-pin question. But forget all that (and don't let yourself be sold by it) and look at rumble and speed-accuracy figures. If rumble and flutter rates (this includes wow) are good enough, forget how the turntable is driven and buy it. As you review such figures, though, you should realize that there are at least three different ways to specify rumble: unweighted, DIN-A or DIN-B weighted. Unweighted figures usually look poorest, followed by DIN-A and then DIN-B, which is the most optimistic. If you see a −70db rumble specification, you can almost be certain that it is a DIN-B spec, and that the same turntable rated on the DIN-A scale could fall into the −50db bracket, or thereabouts. The unweighted figure would look even worse. So make sure you know which rating scheme is in use when you compare turntables, and if you can't find out for yourself, ask the salesman to find out for you.

Finally, there are those sexy-looking tonearms, about which it is fair to ask: how much of that hardware is really going to help my cartridge track records better? Worst offenders in the "heavy tonearm design race" are the Japanese, who built the largest battleships in World War II, and who are now following in that tradition with the arms they supply on many of their good turntables. The average Japanese tonearm is a weighty, clumsy thing; this is one of the few areas of hi-fi in which the Japanese are still playing catch-up. But the British seem to have the best of it.

Both in complex and non-complex arms, the Englishmen seem to have excelled. Best of the complex arms, with every frill useful, is the familiar SME; best of the less complicated-looking arms — and maybe a better performer, though differences are small at this level of excellence — is the Decca, a straightforward, lightweight design using a damped uni-pivot.

All this is not to say that out of the British Isles comes naught but good — there is a lot of scoffing about the advertising claims for the Transcriptors Vestigal tonearm, an Irish import. Without going into detail, the Vestigal arm may be a classic case of technology hype in which vast advantages are claimed for a design which may even be inferior in many ways to standard units like the SME. Study this arm from all angles before buying one.

FETs. Finally, there are FETs, or field-effect transistors, about which it can be said that it will be nice when we can afford them. FETs, or V-FETs, combine many of the advantages of transistors with some of those of vacuum tubes, and there is now getting underway a good-sized campaign to make you feel insecure about your hi-fi if it uses "old-fashioned" transistors. All this is not only inaccurate, but also premature.

Not only are bipolar transistors far from washed up, but they are also very competitive with FETs as far as price and power are concerned. It is true that available FET gear does have a smooth and pleasant sound, but *for the price* it is not that much better than tube or (bipolar) transistor equipment.

The most probable result of the FET's advent in the hi-fi market will be an upgrading of designs using standard transistors; there is a lot that can still be done before we have to cash in our old gear in favor of "vastly superior" FET equipment. Maybe around 1980, the advertising techno-hype on FETs will be nearer the truth; for now, save your money.

The AR turntable guarantee has been extended from 3 years to 5 years.

Ask your salesman if any other company offers this kind of guarantee.

Model XA

Model XB

AR products can be seen and heard at the following authorized AR dealers:

***Lechmeres** 88 First Street, Cambridge, Liberty Tree Mall, Danvers, Route 1, Dedham*
***Tweeter, Etc.** 163 Amory Street, Brookline, 102 Mt. Auburn Street, Cambridge*
***K & L Sound Services** 75 N. Beacon Street, Watertown*
***Olde Colony Stereo** 32 Copeland Street, Quincy Route 3A, Cohasset Route 53, Hanover*
***Wolfe & Smith** 401 Massachusetts Avenue, Cambridge*
***You-Do-It Electronics** 40 Franklin Street, Needham*

The AR performance guarantee

The workmanship and performance in normal use of AR speakers and turntables are guaranteed for five years from date of purchase. The guarantee covers parts, repair labor, and freight costs to and from the factory or nearest authorized service station. New packaging if needed is also free. This guarantee is in effect regardless of where you make your purchase or where the product is used. Any unexpired portion of the guarantee may be transferred to a new owner.

This extension is retroactive and covers all turntables purchased within the past 5 years.

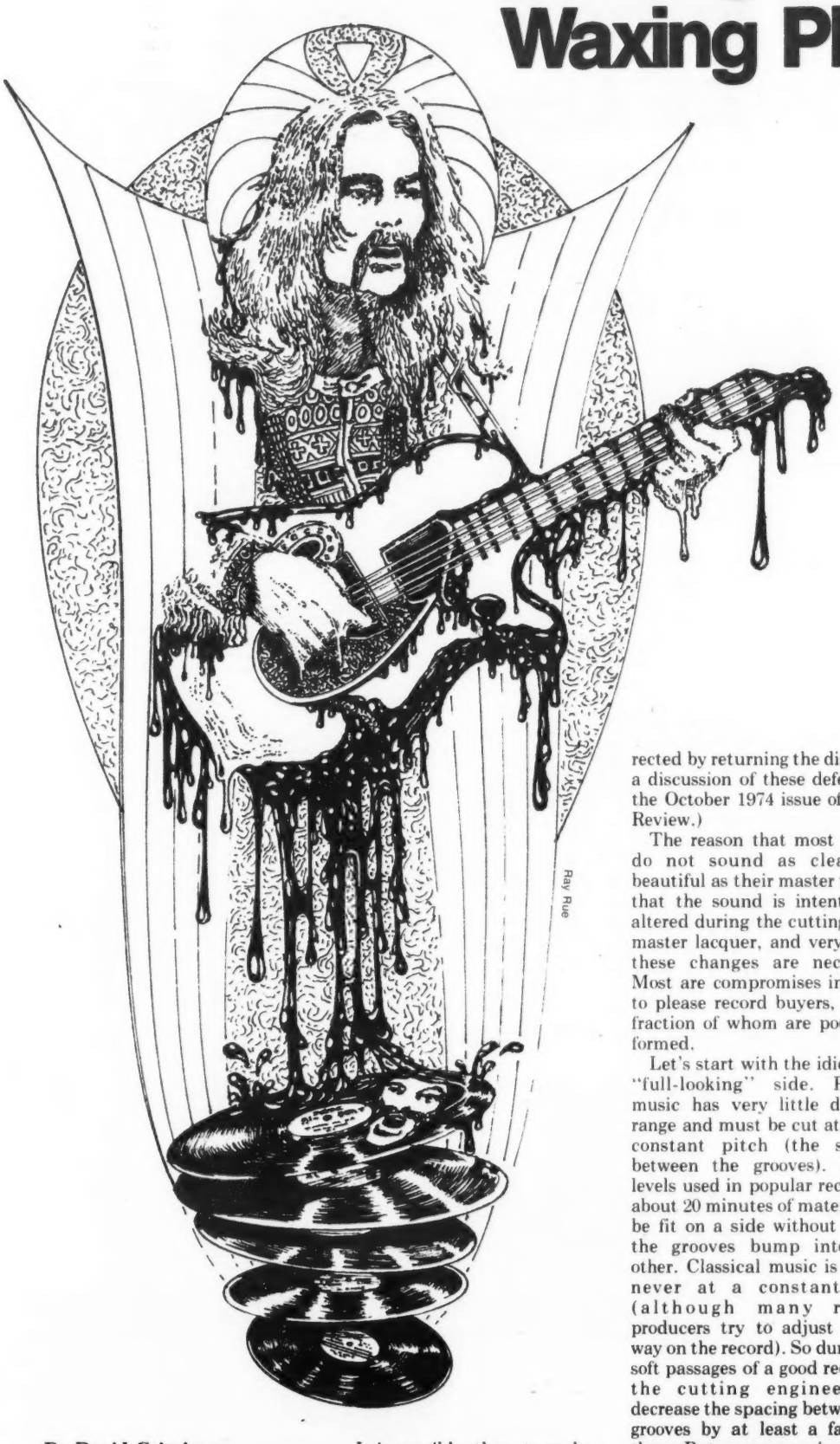
AR

Acoustic Research

US office:
10 American Drive
Norwood, Massachusetts 02062

International office:
High Street, Houghton Regis,
Bedfordshire, England

Cutting Records: Waxing Philosophic



Ray Rue

By David Griesinger

Boston hi-fi buffs are probably all familiar with Victor Campos's program "Adventures in Sound." This program presents original master tapes of various records, played under carefully controlled conditions. The freedom from distortion, as well as the clarity and dynamic range of these broadcasts, is startling. It is a delight to listen to these broadcasts at high volume with all the treble response my system can get. Yet the discs made from these tapes are often disappointing. The dynamic range seems compressed, and the loud passages often are either fuzzy or downright distorted. Playing them loud will drive anyone with good sense and good hearing out of the room.

Is it possible, then, to make a really fine sounding disc?

The answer is yes; in fact, many people think it is possible to make a disc which sounds much better than a master tape. (Direct disc recordings available from Sheffield, P.O. Box 5332, Santa Barbara, Calif. 93108, are good examples of how all discs should sound.)

The traditional problems with records, such as surface noise, warpage, no-fill and scratches, can all be controlled at the plating and pressing plants if the company making the records is willing to spend the time and money. Some modern records are good in these respects. On others, these faults can be recognized by anyone who cares; they can occasionally be corrected by returning the disc. (For a discussion of these defects see the October 1974 issue of Stereo Review.)

The reason that most records do not sound as clear and beautiful as their master tapes is that the sound is intentionally altered during the cutting of the master lacquer, and very few of these changes are necessary. Most are compromises intended to please record buyers, a large fraction of whom are poorly informed.

Let's start with the idiocy of a "full-looking" side. Popular music has very little dynamic range and must be cut at almost constant pitch (the spacing between the grooves). At the levels used in popular recording, about 20 minutes of material can be fit on a side without having the grooves bump into each other. Classical music is almost never at a constant level (although many record producers try to adjust it that way on the record). So during the soft passages of a good recording the cutting engineer can decrease the spacing between the grooves by at least a factor of three. But groove spacing is now done automatically using a computer, and much more music can be cut on a side without the grooves' bumping. However, classical music doesn't break into neat 30-minute chunks. Usually the chunks are shorter. With modern equipment these chunks could be cut using only the outside portion of the disc, especially if the disc is cut at a moderate level. But this is almost never done! As I will show later, the inner bands of a record are almost useless for the recording of really high fidelity sound. Yet recording engineers almost invariably override their cutting pitch computers, and make sure that the finale of the music is cut on the area of the disc least able to reproduce it.

They do this because, otherwise, the uninformed among the public complain. "Look at all that wasted space," they'd say, "I'm getting ripped off." If you really feel that way, you should abandon classical music.

At least a short-looking record is easy to spot. You should look for them, and encourage the companies which have the guts to make them. One of the best of these is Deutsche Grammophon. For all that their modern records are compressed and overcut they do not hesitate to space the grooves properly. (Telefunken, Columbia, RCA, and Nonesuch do not space really properly, though Nonesuch and Telefunken are otherwise meticulous.)

Another major lunacy is the love of a high level. "What?" the ignorant say. "Unless you cut a high level we will hear too much noise." This opinion is utter foolishness. Listen to one of the Sheffield direct disc recordings sometime. These discs have only a moderate level, but unless you are in the habit of leaving your records on the floor, there simply is no noise on these discs. A good record, carefully plated and pressed, has a far greater potential signal-to-noise ratio than even a Dolby A master tape. (A level merely three db lower than usual results only in much lower distortion, not higher noise.)

But many discs have their peaks limited. This *can* be good: peak limiting reduces the number of times the playback stylus momentarily leaves the groove. Mistracking, as this type of distortion is called, sounds horrible to everyone, although it is so common much of the public has come to accept it. Mistracking sounds like crackling. It's a gritty, grating sound, usually sudden and discontinuous. However, there are lots of ways a

Continued on page 10

"Discs distort because of mistracking and the geometrical differences between the cutting and the playback styli . . . . Most record companies try to eliminate tracking distortion through compensation. They run the cutting signal through a computer, which alters the shape of the groove in just the proper way to eliminate the distortion. But the difficulty with this almost universal practice is that different cartridges need different compensation."

In the Beginning: **All About Specs...**

By W. Arkin Kanner

The British comedy team Flanders & Swann had a routine about the audiophile who was so into his woofers and tweeters and his wow and his flutter that his wife was forced into low fidelity with high frequency. While it's not necessary or even desirable to get so wrapped up in jargon that you forget about your family or the music your high fidelity system is designed to play, it can be quite helpful to have a nodding familiarity with the terminology involved and what is meaningful and what is garbage. Then, when you're at the hi-fi show or in a dealer's showroom, you won't be dazzled by somebody else's mouthwork, and you might even dazzle somebody with yours.

The jargon starts off with talk of amplifiers (basic and integrated) and turntables (manual and automatic) and continues with the specifications or measured characteristics of what these machines do or, in some cases, what they do not do.

Simply stated, an **amplifier** takes a small electrical signal from an input source, such as record, tape or radio signal, and enlarges it so that it can be utilized by the speakers. An integrated amplifier contains both pre-amp and amp — in other words, it has a tone control section (usually) and a small amplifier that feeds to a larger one (in terms of circuitry). A basic amplifier is just a big power source converting a small signal to a larger one. Its input signal usually comes from a pre-amp that is an outboard version of the same section of an integrated amp. It is in this section that all the inputs and switching controls are situated, as well as all the tone controls and filters.

With an amplifier, the meaningful facts are what it has in terms of **power** and what it does not have in terms of distortion. Power is a game played not only by national governments and nasty corporations, but also by equipment manufacturers and dealers as well. Power output in terms of watts can be expressed in any number of ways: dynamic power, instantaneous peak power, IHF power and watts RMS (root mean square). An award for creative power should go to the dealer who announced to the world that an amplifier he was selling produced a great many "get-to-your-neighbor watts." The numerical figures of these various ways of measuring output can vary greatly (by factors of two or more). The most rigorous way of measuring an amplifier's power and one that is increasingly being used by manufacturers and being required by consumer affairs bureaus is **watts RMS** into an eight-ohm speaker. This is a measurement of continuous power that's taken with both channels operating at the same time to drive a speaker with an eight ohm impedance. The higher the impedance, the lower the power rating.

Most speakers can be adequately driven with a moderate amount of power. Thirty to forty watts RMS should be ample, although there are some speakers that require more in order to drive them with sufficient punch. There are also a few that require very little power to blast you out of a room.

Once you've established the power of an amplifier, the question is, how clean is that power? Or, how much distortion does it have? **Distortion**, in turn, is a question of how much a signal strays on output from a known input signal. A good amplifier should not have more than one percent distortion. Some have less.

A term I have not used appears over and over again on spec sheets in various forms. Frequency ranges and frequency response refer to the range and accuracy of a component's ability to reproduce a given sound wave. **Frequency,** expressed in Hz (Hertz, or cycles per second), is the rate at which a given wave occurs per second. The lower the frequency (or the larger the wave), the lower the tone sounds. The higher the frequency, the

Continued on page 22

A-2340. The demo-maker.

If you've been wanting to get that demo reel together, want no more. TEAC makes a very affordable recorder that will help you get it down. On tape.

Of course, it has Simul-sync, so you can concentrate on each part of the tune, one track at a time. Add echo, revise and overdub until it's right for you.

Mic/line mixing, individual level controls . . . all the essential features and functions you need to express your creativity, to make the music the best it can be.

We understand multitrack recording—from the basic hardware through the interface gear—and we'd like to discuss with you and demonstrate for you the technology that makes it possible. You take it from there, and provide the art.

TEAC
The leader. Always has been.

740.00

Harvard Square, 38 Brattle St., 661-3100; **Prudential,** 811 Boylston St., 261-2788; **Allston,** 1092 Comm. Ave., 731-5700; **Framingham,** 248 Worcester Rd., Rt. 9 East, 879-6550; **Peabody,** 10 Sylvan St., 531-8888; **Braintree,** South Shore Plaza, 843-2600; **Worcester,** 328 Main St., 757-7700; **Providence,** 261 Thayer St., 831-1900; **New Haven,** 31 Broadway, 772-0000. *Stores also in New York, New Jersey, Maryland, Washington, D.C., Virginia, and North Carolina.*

Atlantis Sound

And How They Can Mislead

By Peter W. Mitchell

Usually, a set of specs is advertised by the manufacturer, and then more sets of specs are published in "unbiased" magazine test reports. They are seductive because they offer a certified and IHF-standardized means of comparing competitive components in the comfort of one's easy chair, unpressured by salesmen and free of the uncertainties of making one's personal judgments of a sound in a showroom.

Specifications and test reports inspire confidence because they are specific: to say that two amplifiers generate little background noise provides no basis for choice, but when published reports say in hard print that one amp has a signal-to-noise ratio of 60db and the other's S/N is 66 db, you are likely to feel confident that one is quieter than the other. Specs and reports also inspire confidence simply because they are published in permanent form in national magazines and so have a character that is lacking a salesperson's ephemeral reassurances. This is related to the "they couldn't publish it if it weren't true" syndrome. And specs gain in authoritativeness because they are standardized; we assume that the parameters that are advertised and tested are the parameters which best predict the sound quality of the equipment. They wouldn't make irrelevant or meaningless measurements — would they?

The fact is that advertised specifications often mean less than they appear to and sometimes are wholly meaningless and even the most accurate and unbiased test reports are riddled with omissions, hidden uncertainties, inflated irrelevancies, confident misinterpretations and precise numbers that don't mean what they are supposed to mean. In my experience, advertised specifications and published test reports have led people to believe more falsehoods than truths about the relative merits of audio components. This isn't a conspiracy; it's simply the result of ignorance, habit and insensitivity to the consumer's need for information that provides meaningful guidance. (Actually, compared with others, the hi-fi industry is saintly, but there is a lot of room for improvement.)

By now, most audiophiles know that a claim of frequency response ("38 to 17000 Hz") is totally meaningless unless accompanied by a statement of uniformity of response (plus-or-minus "X" db). And you know that "EIA peak power" is silly and that "total IHF power plus-or-minus one db" is inflated by about a factor of four over more strict power ratings. Experienced audiophiles also know that a power rating should be associated with a distortion rating and a power-bandwidth specification. But how do you make a choice when faced with two sets of amplifier specs, both quoting the same power-bandwidth, but one claiming a continuous full-power rating of 50 watts at 1% distortion and the other 40 watts at 0.1% distortion? Does the second amp sound better because it has lower distortion? No! These specs, despite their apparent depth of detail, are quite meaningless for the consumer making a choice. (Indeed, both specs could apply to the same amp.)

In fact, in view of today's circuit design practices, it can be stated as a general rule that the full-power distortion rating has no relationship at all to the sound of the amplifier and should be ignored by consumers. The sound of an amplifier is, however, correlated with the amount of IM distortion at average power levels (0.1 watt or so), a parameter which no manufacturer advertises and only one test report writer measures. This is one of several areas in audio where the most-publicized specs are useless and genuinely informative measurements are ignored.

Equally often, test data does not mean what it appears to mean. Consider, for example, the published performance curves on phono cartridges. Test reports always include a graph with two curves to indicate frequency response and channel separation for the cartridge. The frequency response chart is made by playing a test record on which the left channel contains a tone whose frequency is varied through the audible range. The left-channel output of the cartridge, after preamplification and equalization, is fed to a graphical recorder to plot the frequency response. Then to measure channel separation, the test record is played again, but this time the cartridge's right-channel groove wall is recorded. Since the right-channel groove wall of the test record is silent, the right-channel output, that is found is assumed to be a left-channel signal that leaked through to the right channel. This is called "crosstalk." Genuine crosstalk is not irritating to hear; it simply blends the stereo image together a little.

This approach to measuring channel separation and interpreting the result was developed about 20 years ago for early stereo amplifiers and tape recorders in which there were known ways for electromagnetic leakage of signals between channels to occur. For these, the procedure of feeding a signal in one channel and measuring the cross-channel output made good sense, and it was not surprising that the leakage varied with frequency. But this approach to measuring a separation has been applied to all kinds of stereo equipment without adequate consideration of what the results mean.

In the case of modern phono cartridges, in most designs there is no electromagnetic leakage path between channels. The principal cause of genuine crosstalk in cartridges is mechanical misalignment of the cartridge's magnets and generating coils relative to the record groove walls (due both to imperfections in assembly and to your sloppiness of mounting the cartridge in the tone arm). Therefore, true crosstalk should be about the same at all frequencies. Yet, if you look at test reports, you will find that in many cartridges the measured "separation" decreases from about 30 db at midfrequencies to 10 db or less at high frequencies. The test report writers don't tell you (perhaps they don't know) that what they are measuring isn't just innocuous crosstalk.

The graphical recorder responds to any signal coming out of the right channel, be it crosstalk, distortion, noise or whatever. In many cartridges at frequencies near the high-frequency stylus/vinyl resonance, the stylus rattles around in

Continued on page 24

Best for the Record

MODEL 50H MARK II AUTOMATIC TURNTABLE ON WB-700 BASE

Elac/Miracord 50H Mark II Automatic Turntable

The Miracord 50H should be well known to the knowledgeable audiophile. The Mark II version offers an updating of this excellent instrument to keep it competitive, and to improve its usability and performance. Like the original, a hysteresis-synchronous motor is employed; this ensures that turntable speed is totally independent of any reasonable variations in the household voltage. I checked this and it is indeed so. Variations between 80 and 130 volts produce no change in speed.

But if you want a change in speed, you can now have it. A vernier speed control that enables you to vary the nominal speed by 3 per cent up or down is incorporated. There are means to adjust the turntable to true speed. The Mark II has incorporated a stroboscope on the underside of the turntable platter. A mirror arrangement permits its viewing by neon illumination.

Other changes on the new model include elimination of the 16-2/3 rpm speed but retention of the 78 speed. There are also some small but well thought out changes in the tonearm's rear counterweight adjustment, and the arm lock has been modified. Other than these, there is little difference between older and newer models.

Softly sprung pushbuttons are still used for automatic operation. You can still operate the mechanism by these buttons without jarring a record in play. Antiskating compensation is adjusted from the baseboard and stylus force is adjusted from the arm in quarter-gram increments from 0 to 6 grams. To adjust the arm, you first balance it via the rear counterweight, and then dial appropriate stylus force and antiskating compensation.

Two spindles are supplied: a short one for manual play, and a longer one with three stubby arms to hold the stack for changer operation. In the changer operation, no less than two records must be placed on the spindle for the unit to operate—further, the spindle must first be removed at the end of play in order to get the finished stack off.

One special feature is the fact that the short (manual play) spindle can be inserted upside down to permit continuous repeated play of a record side—if that is wanted.

PERFORMANCE TESTS

I mentioned one test earlier. Turntable speed is independent of household voltage variations of 80-130V—the largest range in which any audio component might be expected to perform properly.

The tracking force gauge on the arm was accurate to within 0.2 grams—as accurate as one would want. In addition, there is little change in stylus force between the play of the first record of a stack and the last. It was within the range of the error of stylus force, and thus not measurable.

The playing speed is variable within an actual range of +2.3 and -3.5 per cent. Flutter is extremely low, measuring 0.051 per cent combined flutter and wow at 33-1/3 speed. Rumble is low, measuring an unweighted -39 dB and a weighted -44 dB at 50 Hz. Practically, this is inaudible rumble.

In sum, the Miracord 50H Mark II acquits itself admirably. It is supplied with choice of handsome wood bases; dust covers are available. It deserves consideration in the finest music systems.

Reprinted from STEREO & HI-FI TIMES Sound Views by Larry Zide

ELAC

ELAC PRODUCTS,
Benjamin Electronic Sound Co.,
Farmingdale, N.Y. 11735

DEALERS

BI-RITE — Manchester, N.H.
LECHMERE — Cambridge Danvers Dedham Springfield
TECH HI-FI Boston Cambridge Dedham Stoneham Framingham Worcester Hanover Brockton Amherst Providence, R.I. Nashua, N.H. Dover, N.H. Burlington, Vt. Portalnd, Maine N. Bennington, Vt. Portsmouth, N.H.
WALTHAM CAMERA — Waltham
HOSPITAL PHARMACITY Lowell
MINUTEMAN RADIO — Boston
VALUE HOUSE — Maine New Hampshire Massachusetts Connecticut
RESISTORTRONIC Burlington
BODEX — DBA Radio Shack Associate Marlboro

Miracord Models are available from $129.95 to $279.95

Cutting

Continued from page 7

stylus and cartridge can cause distortion besides mistracking. These other distortion products are usually continuous, which makes them much less obvious, especially if the record is being played at a low volume or with the treble cut. These continuous, low harmonic order distortions can sound much like noise, or what many people call 'mud'.

Peak limiting is effective in reducing or eliminating such mistracking when it is used correctly. Unfortunately, many producers also use it to increase the average level on the disc. Since the music then remains at high levels for long periods, the resulting fuzziness is more annoying. Not only is such a record unpleasant to hear at high volume, the peak limiting ruins most of the music's dynamic (and hence artistic) impact.

Cartridges have improved in the last few years and a first-class modern cartridge can track the high-level passages in a good record with almost no distortion, at least on the outer bands. But some cutting engineers have taken this development into account, and have increased their cutting level until mistracking is almost as likely now as it was before. There are many reasons why *no* cartridge can be expected to play all modern high-level records clearly, regardless of the perfection of cartridge design.

Why do discs distort? They distort because of mistracking, groove deformation, and the geometrical differences between the cutting and the playback styli. Let's consider geometric distortions first. These distortions are called tracking and tracing distortion, and are a major cause of the fuzzy sound of records. For example, a 4000Hz tone cut at a 5cm/sec level will produce 5 percent distortion when played with a .65mil spherical stylus — even at the outside of the record. This distortion rises to 20 percent at a groove diameter of five inches! An elliptical stylus, playing the same grooves, will give about half the distortion (which is still a lot).

As a simple example, imagine a record with vertically modulated grooves being tracked by a spherical stylus. As the distance between the peaks and the wiggles approaches the diameter of the stylus, the path the stylus follows becomes more and more distorted. The stylus spends too much time going over the tops of the wiggles, and then drops suddenly into the valleys. When the curvature of the bottom of the wiggle becomes smaller than the radius of the stylus, a form of mistracking called curvature overload occurs.

Most record companies try to eliminate tracking and tracing distortion through compensation. They run the cutting signal through a computer, which alters the shape the groove in just the proper way to eliminate the distortion. But the difficulty with this almost universal practice is that different cartridges need different compensation. The shape of the stylus is important, though this is not the only reason for different compensation needs. The cutting engineer cannot predict the shape of the groove will have when it is played, since there is tremendous deformation of the groove wall during playback. It is easy to see why. Assume that you are playing a record with an elliptical stylus with radii of .3 and .7 mils. If you have a tracking force of one gram, the contact pressure must be at least 10 tons per square inch. At these pressures vinyl is fluid, and the record surface must deform.

There is considerable deformation of the groove wall each time a record is played. How much the groove deforms, and how much of this damage is permanent, depends on the shape of the stylus, the effective tip mass and the tracking force. Naturally, large spherical styli cause less deformation than small elliptical styli. Records appear to survive playing rather well. When the curves in the grooves are gentle, deformation of the groove wall does not change the path the stylus must follow. But at high levels in the inner grooves, the curves are anything but gentle; the result is distortion and wear.

If the cutting engineer knows the shape of the stylus used in playback, its effective tip mass, and the tracking force, he can adjust his compensator to reduce substantially both tracing distortion and deformation distortion. The distortion will then rise only as the record wears. However, if the record is played with a "wrong" cartridge, the distortion may be much worse than if no compensation were used.

I use an ADC 25 (no longer available) to play most of my records. This cartridge comes with two different elliptical styli, and a .6 mil spherical stylus. The differences in tracing compensation among commercial records can easily be heard by trying the different styli. DG appears to compensate for a rather heavy .7 mil spherical stylus. When played with my light .6 mil spherical, modern DGs sound better than they do with an elliptical, but they are still distorted. Sheffield cuts at a more moderate level, and appears to use no compensation. Their discs sound best with an elliptical. Telefunken also uses moderate levels, and appears to compensate for a spherical stylus. Nonesuch appears to compensate less than DG. There is very little difference between the sound of the elliptical and the spherical styli on the two 1974 Nonesuch releases I own. (This confusion in the choice of compensation makes comparing cartridges very diffucult, since a poor cartridge may sound better on some records than a very good one.)

Finally, we have mistracking. In this case, the stylus will stop contacting the groove whenever the acceleration of the groove wall times the effective tip mass is greater than the force pushing the stylus back into the groove. Resonances and damping the stylus shank can cause the tip mass to seem much higher than it is, and geometrics of the stylus can give the stylus higher accelerations than the level on the disc would suggest. (Mistracking can also be caused by large groove amplitudes, if the cartridge is not compliant enough.)

However, the sound most people associate with mistracking can occur in other ways. For example, if the radius of the groove curvature becomes smaller than the stylus radius, curvature overload can occur, as previously noted. Naturally, an elliptical stylus will help, at the cost of higher record wear. If the slope of the groove becomes greater than the slope of the bevel on the back of the cutting stylus overload again will occur, and there is nothing a record buyer can do about it. Finally, if the grooves bump each other, or if the width of the groove becomes less than the stylus radius, mistracking will occur, although modern groove spacing computers help reduce these forms of mistracking.

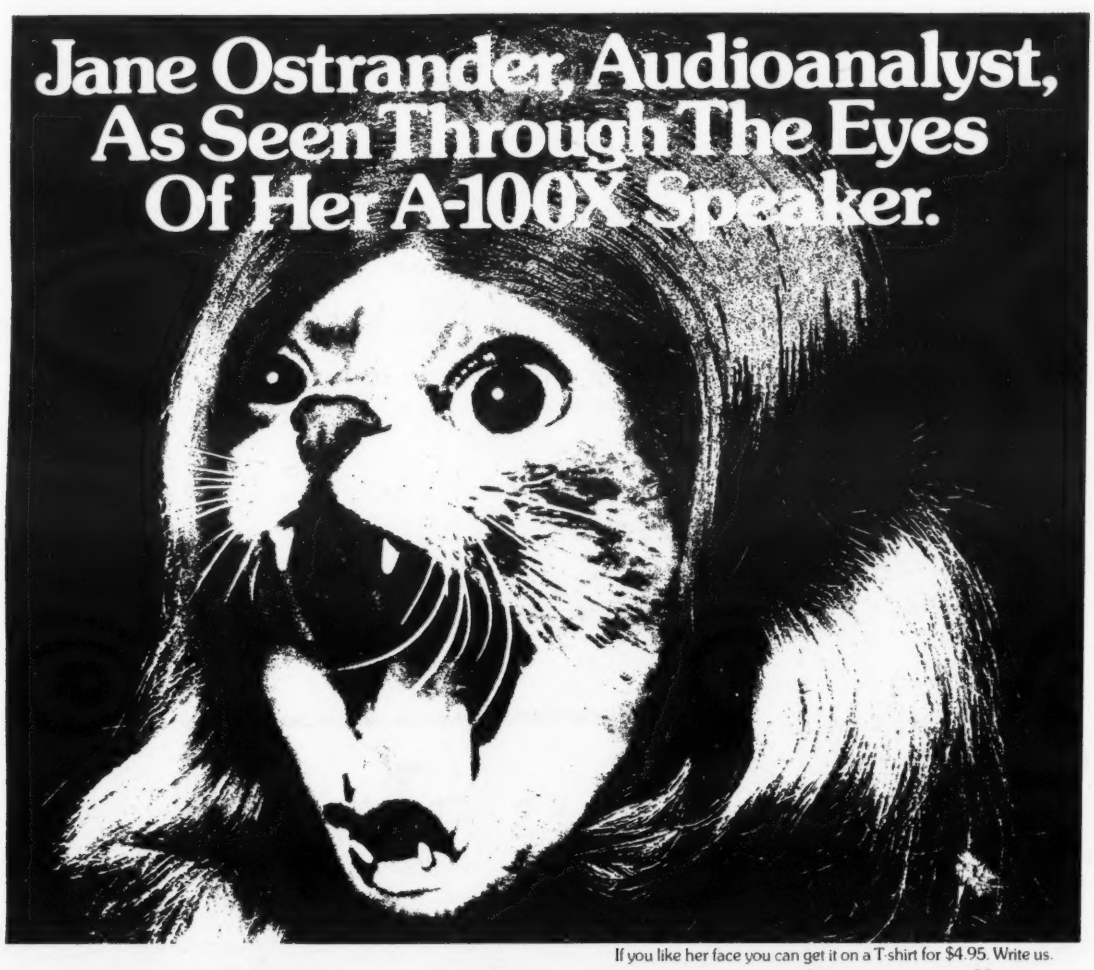
All these defects occur with a certain probability in disc cutting. The solution to them is not to cut in the inner grooves, if possible, and to use less peak level. If you have a record which appears to be cut low level, and yet still mistracks, suspect non-fill or dirt. Dirt tends to stick to the high-level sections of a record. A careful wet wash can remove it — but that's another article.

It's easy to make good records. Recording engineers are not ogres. They are trying to please the producers who hire them, and the producers are trying to please the public and its perceived wishes. Classical music lovers could help by dropping a postcard to the record company whenever they find a fuzzy record. Reviewers could help a lot by mentioning when a disc sounds fuzzy, and when another disc sounds really clean. *Every record could sound spectacularly clean if the right decisions were made.*

The secret is close communication of a producer's tastes to the cutting engineer. The most important step in this communication is a trial cutting (acetate). Such a trial need only include five to 10 minutes of the record, but should include a loud passage, and should be cut near the inside of the disc. The producer can then play this trial cutting on a number of different phonographs and make sure it sounds clean. If limiting has been used (sometimes it *is* essential), the test will show if any of the impact has been lost. I have found that a peak level of only three db lower than the maximum in common use can make the difference between a distorted record and a great one. I also find that if only vertical limiting is used, and only four db of that, the loss is very hard to detect, and can make a cleaner record.

Ultimately, cutting good records is a matter of care and good taste — just like the process of making the music being recorded.

Jane Ostrander, Audioanalyst, As Seen Through The Eyes Of Her A-100X Speaker.



If you like her face you can get it on a T-shirt for $4.95. Write us.

Stereo Review calls her product "Superb."

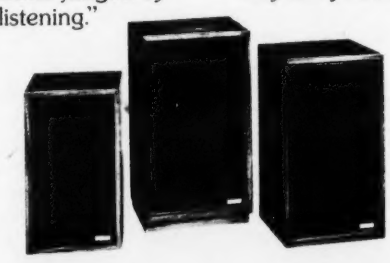
Jane Ostrander. Proper Pilgrim

Hirsch-Houck Laboratories: "Smooth frequency response claimed for the A-100X was confirmed by our live-room frequency response measurements. Overall, the accuracy of the A-100X ranks very high, whether judged by this test or simply by critical listening."

Blame it on an obsession with quality control. Plus specifics like powdered iron core inductors (average bears use ferrite or air), Mylar* capacitors in high frequency circuits and metal film resistors. These work for our speakers and our speakers work for you, $94 to $249, with a Six Year Warranty. Write. We'll arrange a test. No way can you drive our drivers nuts.

MEMBER IHF INSTITUTE OF HIGH FIDELITY

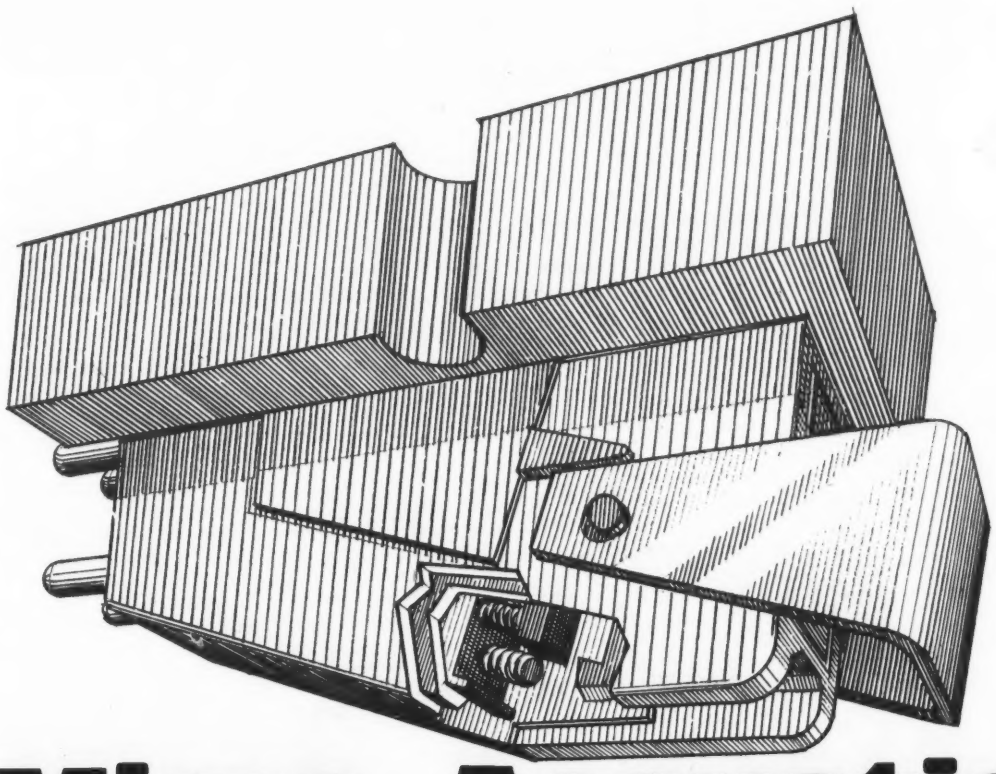
*Mylar is a registered DuPont trademark



Audioanalyst

P.O. Box 262, Brookfield, Conn. 06804
Monstrous About Perfection

Distributed in Canada by Superior Electronics, Inc.



Why you should buy the Micro-Acoustics QDC-le stereo phono cartridge.

A well recorded stereo disc is *potentially* every bit as good as the master tape from which it was cut. But until the introduction of the Micro-Acoustics QDC-le stereo phono cartridge, there really wasn't a cartridge on the market that could make a stereo record sound as good as its master tape.

The QDC-le is an ultra precision component that neither adds nor detracts from the music you hear. It can make *any* component music system sound better!

Why you should buy it at Tech Hifi.

Setting up a component music system in your home is surprisingly simple, until it comes to installing the phono cartridge in the turntable. Not only is this often a difficult operation, but it is also critical to the satisfactory performance of your system.

So just ask us, and we'll be glad to expertly install the cartridge for you when you come to pick up your system. At the same time, we'll show you how to calibrate the tracking force and anti-skate adjustments on the turntable, for maximum performance with whatever cartridge you've chosen.

This is just one of the advantages that Tech Hifi offers. Come here for low prices, a great selection of components to choose from, knowledgeable salespeople, excellent component comparison facilities and fourteen *important* Customer Satisfaction Guarantees.

They *guarantee* you'll be happy with what you buy at Tech Hifi... whether it's a Micro-Acoustics cartridge or a complete system.

Come, hear.

tech hifi
Quality Components at the Right Price

Massachusetts 240A Newbury St, 870 Commonwealth Ave, Boston 38 Boylston St, 182 Massachusetts Ave, Cambridge, Route 9, Framingham, Route 1, Dedham 352 Main St, Stoneham 667 Main St, Waltham 279 Main St, Worcester 48 Teed Dr, Randolph 186 Main St, Northampton 253 Triangle St, Amherst **Connecticut** Caldor Shopping Center, West Main St, Avon **New Hampshire** 2 Worth Plaza, Portsmouth Main St, Hanover, Nashua Mall Extension, Nashua **Vermont** 150 Church St, Burlington 21 Main St, North Bennington **Maine** 342 Fore Street, Portland **Rhode Island** 165 Angell Street Providence 1989 Post Road, Route 1, Warwick

A Case of Tape

By Herkimer Bell

When considering the purchase of a new tape recorder, you might be tempted to carry a cassette or reel of good tape around and make trial recordings on a half-dozen recorders, choosing as "best" the machine that makes the most accurate recording with your sample blank tape. Will this procedure get you the recorder having the best frequency response? NO. Indeed, there is no assurance that the recorder you unpack at home will perform as well with your sample tape as did the recorder in the store. In general, the accuracy of a recording does not simply depend on the quality of a recorder — in fact, it is entirely possible for a recorder which is superior in design and construction to make a poorer recording than a cheaper machine using the same tape. A basic fact to remember is that, if properly adjusted, nearly every over-$150 recorder on the market is capable of flat response over most of the audio range, so that apparent differences in frequency response among machines should *not* be considered meaningful in making a buying decision.

After you buy a tape deck and get it home, if you don't know whether to believe the advertising for various brands of tape you might reasonably decide to try a sample of each brand. Is the tape that makes the most accurate recording in this test necessarily the "best" tape? Maybe. And maybe not. The accuracy of a recording does not depend simply on the quality of the tape; the "best" tape from a technical point of view may make lousy recordings on your machine. But in principle, nearly every brand and type of tape on the market can be made to produce accurate, flat response on your machine.

The key to this situation is that tape recording is a synergistic process, one which depends as much on the relationship between the tape and the recorder as it does on the individual quality of each. This is why it can happen that a "better," more expensive tape may actually produce worse recordings on your machine than a cheaper tape.

The magic words here are "bias" and "equalization." *Any* good tape recorder will exhibit accurate response with *any* good tape, *if* the machine's bias and equalization adjustments are set properly for that tape by a technician. This refers not only to any front-panel bias switch that the machine may have, but also to the internal bias controls connected to each position of the bias switch.

Though bias-and-equalization are so often discussed together that they might as well be a single word, they actually serve very different functions in the circuit. The bias current is a constant ultrasonic signal applied to the tape together with the audio signal. How the bias current works to perform its miracles is too complex and subtle to describe here, but it really makes a difference: the right amount of bias current reduces distortion and as a bonus makes the recording process less sensitive to tape imperfections such as dropouts. But the amount of bias required depends on the electromagnetic properties of the tape, which is why you cannot choose tape at random and expect to get good results. In general, the low-cost standard-oxide (brown oxide) tapes require a modest amount of bias current. The better varieties of tape with low-noise, high-output black oxide require increased bias current for minimum distortion, and CrO_2 tape requires still more.

Tape recorders use equalization (treble boost in recording and roll-off in playback) to obtain a low-noise recording combined with flat response. The high-performance varieties of tape are inherently more sensitive in the treble than are standard oxide tapes, so different equalization settings should be used to get accurate response. In general, then, when you (or a manufacturer) are starting out from scratch to mate a new type and brand of tape to a recorder, the technician may have to adjust both the bias current and the equalization.

You may now see that a brand or type of tape which sounds shrill or dull on your machine is not inherently shrill or dull; it's simply that your machine has not been adjusted internally to elicit flat response from that particular tape. And if you find yourself tempted by the grandiose advertising claims made for new types of tape, remember that you probably will have to invest in a trip to the service shop in order for your machine to work well with that new tape. If your recorder is not now providing accurate response with your favorite brand of tape, you can get flat response by having it adjusted (unless, of course, it also needs a new head or other repair). To get the most accurate bias adjustment, supply the service shop with a fresh reel or cassette of your favorite kind of tape when you bring in the machine.

Correct mating of the recorder to the tape is especially important when Dolby noise reduction is used. In order to eliminate tape hiss, the Dolby circuit "encodes" the signal in recording and "decodes" it in playback. If the recorder doesn't play back the same signal that was recorded, the Dolby won't receive the proper decoding cues and may produce a varying high-frequency response. As long as you use the tape that the machine is adjusted for, the Dolby will work fine.

If your recorder is fairly new you shouldn't have to have it rebiased; just find out what kind of tape the manufacturer adjusted the tape for at the factory (your dealer should know). If not, invest in a 10-cent stamp and write to the factory.

Sansui Best Buy of the Month.

Sansui 771/S-1 System

Any Sansui product is always the best buy available anywhere. But no system is better than its weakest component. • For this month, Sansui has selected what we consider the ideal system that will satisfy the most sophisticated audiophile and at the same time be gentle on the pocket. • Each of these components represent the highest value in its price class. Remember no system is better than its weakest link. • The Sansui 771/S-1 consists of a Sansui 771 AM/FM Stereo Receiver; 2 Sansui SP-2500 3-way, 5-speaker, multi-directional speaker systems; Sansui SR-212 Automatic Turntable; Sansui SC-636 Stereo Cassette Deck with built-in Dolby record/playback circuits. • The Sansui 771/S-1 family of products, is highly recommended by the undersigned franchised Sansui dealers who fully guarantee the excellence of these products.

SANSUI ELECTRONICS CORP.
Woodside, New York 11377 • Gardena, California 90247
Sansui

DEALERS

• STEREO SOUND
Boston
Cambridge
Burlington

• TWEETER
Brookline
Cambridge
Brockton
Chestnut Hill

• MINUTEMAN
Cambridge
Lawrence

• TECH hi-FI
All Locations

• K&L
Watertown

• NEW ENGLAND MUSIC
Portland, Maine

• NANTUCKET SOUND
Hyannis

• APEX
Pawtucket

Announcing the Rodney A. Bell Memorial Sale.

Rod does our sales forecasting and inventory planning.

He led the way in JBL's decision to introduce The Decades — three loudspeakers between $100 and $200.

The L36. A superb 3-way bookshelf speaker at $198.

The L26. The first Decade and still champion at $156.

The L16. Almost like the L26 for $21 less. $135.

Well, Rod was two-thirds right. The L36 and the L26 have been breaking sales records since their introduction.

The L16? It's breaking warehousing records.

The $21 difference isn't enough. The JBL customer goes right past the $135 Decade and chooses the $156 Decade.

So, the only thing we can do to make a bigger difference is to take something out of the L16. And the only thing we can take out is some of the price.

Now — while they last — you can get a JBL loudspeaker for $99. (It's so much better than anything near it in price that one listen is all you need.)

Go see your JBL dealer. Ask to hear the Decade L16. Tell him Rod sent you.

JBL. Under $100.

James B. Lansing Sound, Inc./3249 Casitas Avenue, Los Angeles 90039/High fidelity loudspeakers from $99 to $3000.

Getting Used to Used

By Bill Politt

When was the last time you were really hustled? Was it when you bought a pound of sugar at the supermarket, or filled your tank at the pumps? Ripoffs like these may be with us for a long time, but there is a fairly painless way to avoid most of the hassles of acquiring stereo equipment: buy it used. Audio equipment, after all, is too expensive to be thrown in a sanitary landfill when it is no longer wanted. Just consider the vast number of components built since the advent of stereo (even of mono) which are still in circulation, and the number which at any given time must be for sale.

How do we find out, then, just what it is that we want and where we are going to find it? Let's take last things first and discuss "where." The three major sources of used audio are friends, dealers and classified ads. Suffice it to say that the experience of buying, selling and trading with your friends at least lets you know who your friends really are.

Dealers pose a very different problem. They are all your buddies; until you hand over the cash and walk out the door with your unit. At that point, the honeymoon ends. Remember that, in the majority of cases, the dealer took the unit grudgingly in trade, gave the original customer half of what it was worth and is charging you twice that. Two-week return privilege, a legitimate guaranty? Don't expect it. In fact, two of the largest chains in the Boston area (rather than make a serious effort to develop a market in used gear) simply ship out vast quantities of the stuff to out-of-town dealers at outrageously low prices. These retailers are so hungry that they want to be assured that potentially competing bargains are driven completely out of the Boston marketplace.

As long as we seek out quality and not fall for marketing muscle, there is less chance we can get into trouble. Ignore the row upon row of gleaming goodies at "this week only" special prices, but be sure not to miss the few units that will show up on the shelves of the smaller, reliable shops. These quality-minded companies do a pretty fair job of culling out the trash and generally offering only good equipment at reasonable prices.

The small stores have several disadvantages, as compared with the giants. They give good, often in-house, service, and they offer liberal return and warranty terms. These things cost money, so expect fair, not bargain-basement prices. However, the increased dependability of their equipment easily justifies the slightly increased cost.

Shopping in the classifieds requires both specialized skills and a lot of good luck. You must develop a pretty strong working knowledge of both the list and real values of a wide range of units. You must also be able to read the character of your would-be seller. After all, most people sell their used cars in order to give their headaches to somebody else. There are those who get rid of used audio equipment for the

Where to Unload

The Boston Stereo Exchange, at 1589 Commonwealth Ave., Brighton, wants all your used equipment and will pay reasonably for it.

The store offers two exchange options to help you unload your old amplifier, for example, and allow you to move onto that new 1000-watt model you've been dreaming about. Option #1 guarantees you instant cash but most likely the lowest profit margin. The Exchange purchases your used equipment at a price you can both agree upon. Option #2 does not ensure sale but holds out the promise of the highest return. You set the price and agree to let the Exchange sell it for a commission of approximately 15-20 percent.

In spite of the local stereo sales slump, William Moore, owner of the Boston Stereo Exchange, says his business is booming. His success is probably partly due to his fully staffed service department, which enables him to guarantee all the equipment he sells.

Store hours are Monday-Wednesday, 10 a.m. - 9 p.m., Thursday-Saturday, 10-6.

—Alvin Foster

You can buy a little AM/FM radio for twenty bucks.

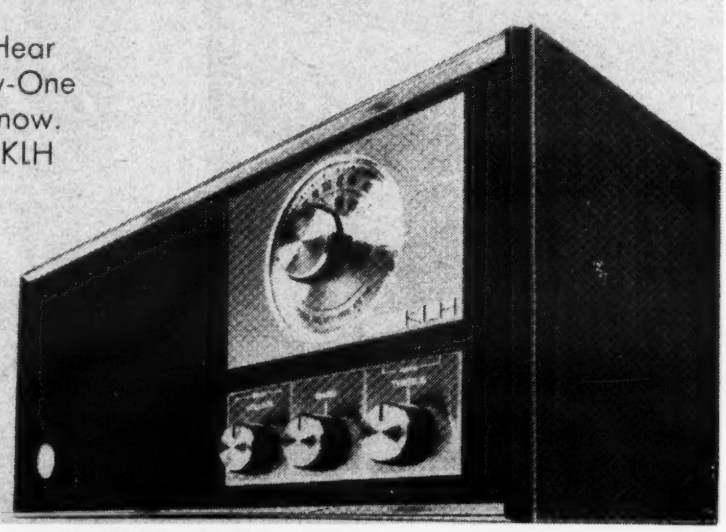
So why spend $119.95?

The answer is obviously better sound. But how much better? The fact is that most radio stations, particularly FM stations, are putting out a terriffic signal. But by the time the music reaches you via a dinky radio, it sounds like it's coming through a paper cup on a string. What serious music listeners have always needed was a serious high fidelity radio. A radio with real power. Highs that sing. And lows you could feel. A radio with super sensitivity. And an AM section that made even traffic reports, time checks, "pop forties" and "moldy oldies" sound good.

In short, what was needed was the KLH Model Twenty-One . . . a neat, compact AM/FM radio that delivers an astonishing amount of sound. Now you might think it takes a lot of nerve to charge $119.95† for a small radio.

Not really.

What it takes is a lot of radio. Hear it soon. The KLH Model Twenty-One AM/FM radio. At your dealer now. For more information visit your KLH dealer or write to KLH Research and Development, 30 Cross St., Cambridge, Mass. 02139.



KLH®

KLH RESEARCH AND DEVELOPMENT CORP.
30 Cross St., Cambridge, Mass. 02139

†Suggested retail price.

AVAILABLE AT:

BI-RITE
Manchester, N.H.

BOSTON MUSIC
116-122 Boylston St.
Boston

BRIGGS & BRIGGS
1270 Mass. Ave.
Cambridge

COPLEY CAMERA
480 Boylston St.
Boston

GLASS SAIL BOAT
3 Duncan St.
Glouscester

classifieds classifieds

The Boston Phoenix

ADS MAY BE PLACED AT:

Classified Office
536 Comm. Ave.
Kenmore Square

Mon-Fri 8:30 -6; Wed 8:30-7

Deadline at places below, 3PM Thurs. unless otherwise noted.

Tisdells Sandal Shop
1160 Mass. Ave
Harvard Square

+Tech HiFi
240a Newbury Street

Boston, Mass.
+Tawa the Ancient
98 Charles Street
Boston, Mass.
Tech HiFi
38 Boylston Street
Cambridge, Mass. (Harvard Sq.)

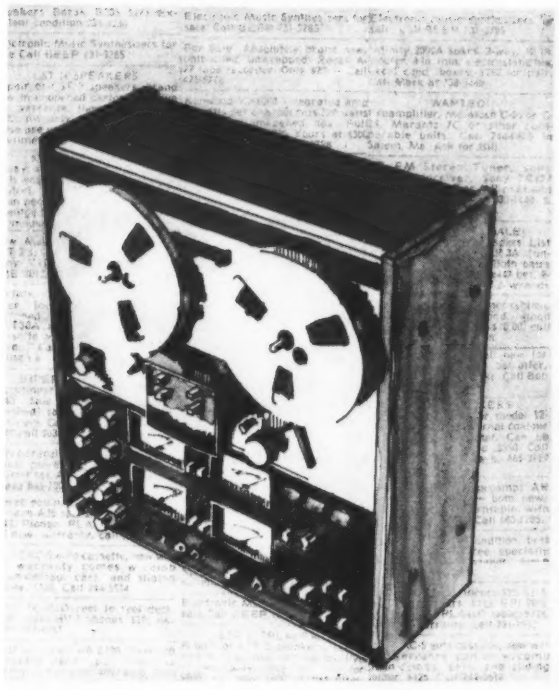
New England Music City
541 Comm. Ave. Kenmore Sq.

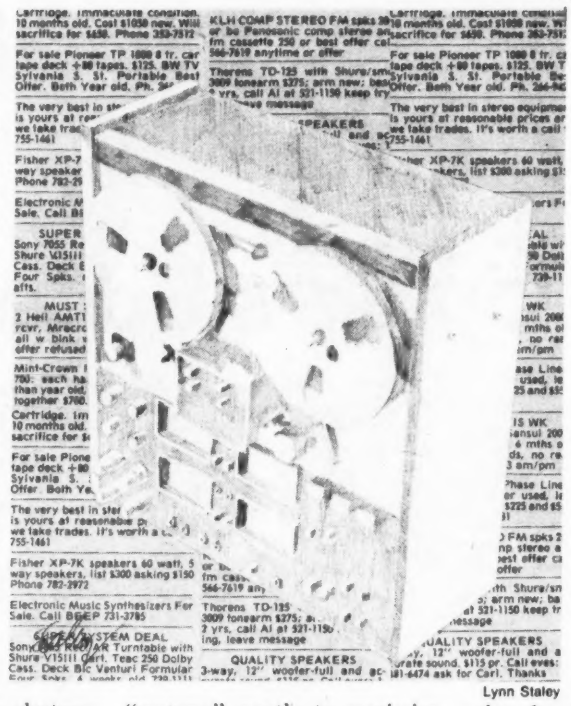
+Tech HiFi
182 Mass. Ave.

Cambridge, Mass. (MIT)
Paperback Booksmiths
753 Boylston St.
Boston, Mass.
(Coolidge Corner)
Brookline, Mass.
Chestnut Hill Mall
Chestnut Hill, Mass.
*Cape Cod Mall
Hyannis, Mass.
+Natick Mall
Natick, Mass.
*Worcester Mall
Worcester, Mass.
***Deadline 5 PM Tues. preceding desired issue.**

+Deadline 5 PM Wed. preceding desired issue.

24 hours a day, 7 days a week, pre-written forms with payment can be left under the door at our office.





"In any used equipment, we are looking for the ideal ratio of sound to price. Of the two, only the sound is non-negotiable. So don't be afraid to haggle with any seller or dealer."

Lynn Staley

same reason.

Where do we start looking to find our gambling casino of audio? The *Phoenix* classifieds represent a fairly accurate cross-section of the local stereo market. The equipment and the prices run the gamut from very good to outrageously bad. The *Want Advertiser*, for some reason, seems to specialize in strictly middle-priced stuff. *Audio* magazine is nationally circulated and directed to a presumably informed readership. If you are prepared to deal through an *Audio* ad with someone 1000 miles away for a piece of expensive gear, sight unseen (or sound unheard) you are already looking for trouble.

There are some general rules for buying used equipment from any source. Amplifiers, tuners and receivers are fairly straightforward to diagnose. Transistors being what they are, if the unit turns on, sounds good and stays on until it is shut off manually, nothing too serious can be wrong. The same can be said of turntables and cartridges. If they can handle a normal (warped and overmodulated) record once, chances are that they will continue to do so. Tape recorders require not only a listening test for electronic and mechanical failure, but also a physical examination for brake, clutch or other subtle misadjustments.

Loudspeakers are complicated enough to merit a separate article. All the training or experience in the world cannot tell you which speakers to like. Once you eliminate the speakers that sound *bad*, it is left to your own tastes to select from among those that sound *good*. Choose used speakers exactly as you would new ones. Listen long and carefully to a record you know well. Do not expect a speaker to zap you out of your chair with exaggerated bass or treble. Just seek out the sound that, to you, is "natural."

In any used equipment, we are looking for the ideal ratio of sound to price. Of the two, only the sound is non-negotiable. So don't be afraid to haggle with any seller, dealer or private party. Be firm when you encounter flaws, even cosmetic blemishes, because these, if nothing else, reduce the value when you try to resell.

A few components have become almost legendary in the used market. Some of them are the Marantz Models 7, 9 and 10B, the MacIntosh MA-2100, the Revox A-77 and the KLH 9. A working unit of these will promise extended performance and good dollar investment to boot.

If your needs tend toward Land Rover dependability, we can enlarge the list to include the entire MacIntosh line, Tandberg tape decks, the Thorens 124 and 125 turntables, the KLH 5 and 6 speakers and just about all fairly recent Japanese electronics. But if you are a connoisseur, consider the SAE amplifiers, Crown recorders, electrostatic speakers in general and products by several of the small foreign specialty companies like Radford or Stax.

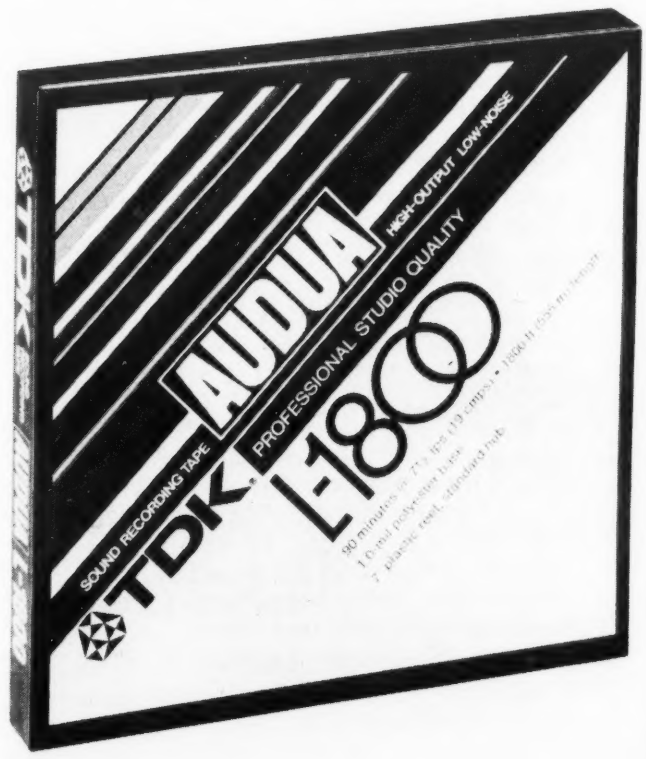
Keep about as far away from house brand units as you would from Typhoid Mary's diner. Dealers put together new "systems" mostly to maximize profits; these packages have no place at all on the used market, so avoid them, too. When every salesman in town tells you that an AR amplifier or a Dynaco Stereo 120 will roast your speakers, listen to him (though when they don't (*i.e.*, when they work), they're great values). Do not buy a Marantz Model 16 and expect it to work longer than any other famous loser. Stay away from companies that seem to change models more often than you change socks. And avoid companies that advertise heavily in the national magazines but seem to have no local dealers: you could get stuck with having to spend more to send your unit back to the factory for repairs than you did for the unit itself. In short, ask advice from those qualified to give it; use good, plain horse sense; and, when in doubt, *don't buy*!

Don't be intimidated into thinking that the used stereo market is just the grisliest thing going. It can cause you intense misery or deep gratification. Used equipment can make you swear at it or swear by it. But it is all out there somewhere, and you really ought to give it a try.

A PRICE BREAK ON SOME OF THE WORLD'S FINEST TAPE TDK

ED Cassettes

Audua Open Reel



Available At Your Nearest Participating TDK Dealer

the new dynamic world of TDK

TDK ELECTRONICS CORP.

STP: The Audiophile's Edge

By Robert Graham

No one would think of riding in an automobile that didn't have shock absorbers, and anyone who has ridden in a car with poor shocks knows just how uncomfortable and unsteady the handling is. Yet your phono cartridge is asked to track bumps and wiggles that make the worst road look like a piece of plate glass, and most tonearms have no "shock absorbers" to soak up this torture. There *is* a cure for the bad effects of all this, however, and it's called "tonearm damping."

The importance of such damping was recently brought home to me through an article which appeared in the Boston Audio Society's February newsletter, a technical discussion of viscous damping and its effect on a modern tonearm. I remembered my early days in hi-fi (20 years ago), when the Weathers turntable was considered one of the more revolutionary (no pun intended) turntables. "Oohs" and "ahs" could be heard whenever a salesperson would toss its arm onto the spinning disc: the Weathers arm had viscous damping of its pivots, so nothing bad ever happened when the arm was dropped thus onto the record. It merely settled very gently into whatever groove happened to be beneath it at touchdown. At the time, this didn't impress everyone, but how wrong we were!

Author's turntable; note STP trough

I didn't think too much about pivot damping again until recently — and so that amounts to quite a number of years of less-than-optimum performance from the tonearms I owned during that time. True, a few years ago I decided to improve the performance of my AR turntable by adding the Shure-SME tonearm. This combination worked very well until I began to try some of the newer cartridges. When I added an ADC 10E/ Mk IV, for example, I noticed a definite "wow" to sustained tones from any record that had even little warps in it (which, as we all know, is virtually every disc in existence). I could actually see the stylus flopping around *independent* of the tonearm when these warps came along (the arm should track warps, not the stylus; it should not move independently of the tonearm). The only cure was to go to an older cartridge, less compliant. This was somewhat frustrating, however, because the more recent models had otherwise better performance. More recently, I added the ADC XLM (my older cartridge had become too worn). The same problems occurred again, but I decided to live with it for the time being. The arm I was using at this point was the SME 3009 Series II. When SME announced their new Improved version, I purchased it, feeling assured that its reduction in mass would cure my problems of wow forever.

Almost, but not quite. True, the arm did perform a lot better, but there were still some warped records, particularly of organ music, where the arm bounced several times after each sharp warp and I could hear the tones being modulated by this. At this point, happily, the article on viscous damping appeared and I tried its experiment, which at once virtually eliminated the problem. The principle of viscous damping can be demonstrated by placing your hand, fingers together, like a paddle, in a pan of water and moving the flat of your hand very slowly through the liquid. You will feel almost no resistance. If, however, you try to move your hand quickly, you will feel considerable resistance, and the quicker you try to move it, the more resistance you will feel. This is how a damped tonearm works. It will follow the relatively gradual motions of warped records, but the damping action will "put the brakes" on any bounce following the warp. This is quite different from and far superior to merely taking an undamped arm and tightening up the bearings to make it "drag." That is dry friction, and will degrade performance.

The improvement in performance lies not only in the playing of warped records more successfully, but in the lowering

Continued on page 21

Klipsch Talks Price

We recently raised prices 4.3% on items the public buys most. And this raises the question of the prices of our products compared with the value received.

For example, a KLIPSCHORN® loudspeaker in oiled walnut, style B, was recently raised to $1040. Ten years ago the price was $884. In that same period of time the humble Volkswagen has gone to about $2665 from $1565.

Value

Maybe I should have titled this ad "Value," because that's where my heart is right this moment, and really has always been, with regard to the audio buying public. That public of course, is not the reason for our success. They are our success.

Stable Design

To me, one of the most desirable features of the KLIPSCHORN has always been its stability. Its design remains today largely unchanged since it was stabilized in 1952. Our dealers relate to us what a joy it is to have their Klipsch customers who own five, six, or fifteen years old KLIPSCHORNS bringing in potential buyers for the same products they own.

No "Major Breakthrough"

Dealers seem particularly proud not to have to eat the "major breakthrough" of the previous selling season, or to worry about whether to buy this year's "Cosmic Muffin"

or next year's speaker with the built-in waterfall and personal vibrator.

Lifetime Investment

We like for people to buy our loudspeakers. But we also like for them to use our loudspeakers the way they were meant to be used: as lifetime investments. Considering the small price increases and lifetime of enjoyment afforded by Klipsch speakers we believe you'll find no greater value in the enjoyment of reproduced sound.

Paul W. Klipsch

Hear Klipsch loudspeakers at the following dealers:

WELLESLEY, MA.
Music Box
58 Central St.
235-5100

NEWINGTON, CT.
Hi-Fi Stereo House
90 Cedar
203-666-4505

BURLINGTON, VT.
Audio Den
100 Dorset St.
802-863-4398

PORTLAND, ME.
New England Music
219 Congress St.
207-772-2862

PROVIDENCE, R.I.
Stereo Places, Inc.
1565 Mineral Spring Ave.
401-353-6660

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 1

TEAC

HP 100 High Velocity Stereo Headphones

List $49.95

NOW $19.95

SAVE $30

COUPON MUST BE PRESENTED AT TIME OF PURCHASE
VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 2

SONY SUPERSCOPE

TC-66 Portable Cassette Recorder

List $75

NOW $50

SAVE $25

COUPON MUST BE PRESENTED AT TIME OF PURCHASE
VALID UNTIL MARCH 29

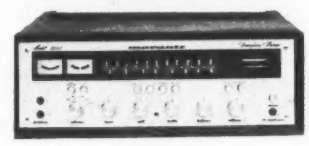
THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 3

marantz

2245 Receiver

- 45 Watts RMS/Channel,
- 20-20 KHZ, THD 0.3
- Walnut case optional

List $500



NOW $319

SAVE $181

COUPON MUST BE PRESENTED AT TIME OF PURCHASE
VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 4

PIONEER

TP224 8-Track Car Tape Deck with 2-TS163 Flush-Mount Speakers

List $70

NOW $39

SAVE $31

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 5

AKAI

CS 30-D Cassette Deck

- Wow/Flutter Less than 0.15% RMS • Frequency Response 40-15 KHZ • S/N Ratio Better than 54dB

List $170

NOW $85

SAVE $85

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

If you have college I.D. or our BRANDS MART wholesale courtesy card, our closed door wholesale showroom is open to you. Come in and choose from our large selection of name-brand audio equipment at rock-bottom prices or from any of these coupon offers! Our T.V.'s, major appliances and air conditioners are comparably priced.

At BRANDS MART you don't get clipped. YOU do the clipping.

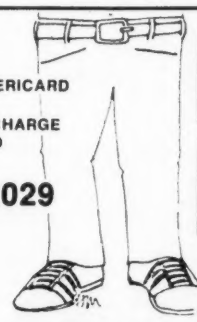
BRANDS MART
INCORPORATED
280 FRIEND ST. BOSTON, MASS. 02114
— OPPOSITE NORTH STATION —
(617) 742-2029

If you are not a student or a faculty member or presently a Brands-Mart-Wholesale-Courtesy-Card holder, you MAY still qualify — Have your organization, association or union representative call Gene Heighton at 723-9230 and inquire

SIGNATURE AND AFFILIATION

WHOLESALE COURTESY CARD

5 YEAR EXTENDED WARRANTY
Available on all audio equipment
Includes: service, parts & Labor
Full manufacturers' guarantees are always included



BANKAMERICARD AND MASTERCHARGE HONORED

742-2029

BRANDS MART
2nd FLOOR
280 FRIEND STREET • BOSTON
FREE PARKING ACROSS THE STREET OR REIMBURSEMENT AT ANY NEARBY LOT

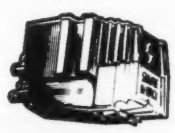
HOURS: Mon., Tues., Fri. 9a.m.-6p.m. Wed., Thurs., 9a.m.-9p.m., Sat. 9a.m.-2p.m.

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 6

SHURE

M 91ED Cartridge

List $55



NOW $15.99

SAVE $39.01

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 7

Dual

1229 Turntable with Walnut Base, Dust Cover & PICKERING Cartridge

List $325

NOW $179

SAVE $146

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 8

SHERWOOD S7010 AM/FM Receiver 10 watts RMS,40-20KHZ

2 Panasonic. 0.9 THD Air-Suspension Speaker Systems

BSR 2260X Turntable With SHURE M81 Cartridge

List $382

NOW $189

SAVE $193

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 9

KLH 55A AM/FM Receiver 13 watts RMS, 45-15 KHZ 2.1 uV FM

EPI Microtower X 75 Loudspeakers

BSR 2520W Turntable with ADC K7E Cartridge

List $514

NOW $289

SAVE $225

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

THE "I-DON'T-WANT-TO-GET-CLIPPED" COUPON NO. 10

Technics by Panasonic SA6000X B.T.L. 2/4 AM/FM Receiver 1.9 uV FM 30 watts RMS 20-20 KHZ 0.5 THD Walnut Case Incl.

2 KLH 6V Speakers

BSR 2620W Turntable with Walnut Base and ADC K5E Cartridge

List $809

NOW $389

SAVE $420

COUPON MUST BE PRESENTED AT TIME OF PURCHASE VALID UNTIL MARCH 29

Why you should buy the Pioneer PL12D turntable.

If you're the kind of person who is more concerned with performance than with minor conveniences, the Pioneer PL12D manually-operated turntable will suit you just fine. It features a 4-pole synchronous motor for smooth rotation. Wow and Flutter is only 0.1%, as good as many turntables costing twice as much! The belt-drive mechanism keeps "rumble" better than –47dB. This means that you'll never hear motor noises mixed in with the music from your record albums.

The Pioneer PL12D has a statically-balanced, S-shaped tonearm that will track your records with as little as ¾ of one gram of pressure. An anti-skate control keeps the stylus centered in the grooves. A cueing device simplifies operation while protecting your records from careless handling.

And for all its performance, the Pioneer PL12D manual turntable sells at an extremely reasonable price which includes a handsome wood base, and a hinged dustcover.

Why you should buy it at Tech Hifi.

Tech Hifi sells more Pioneer high fidelity components than any other audio specialty store in New England. So we can sell the Pioneer PL12D to you for the lowest possible price. (Especially when you buy it as part of a complete system.)

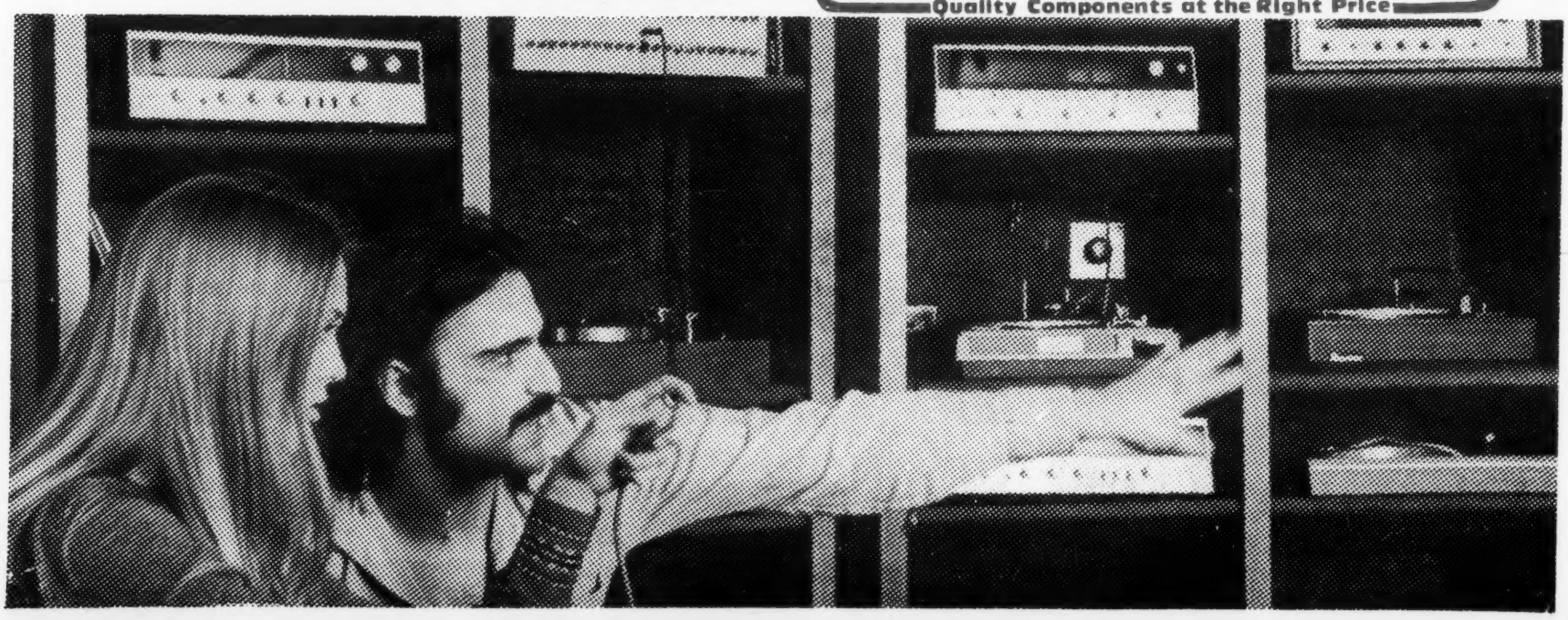
If you already own a good component music system, and want to make it even better with this high-performance manual turntable, we'll be glad to take your old turntable in trade and give you a good price for it.

And if anything should go wrong with the turntable, Tech Hifi will fix it in our own, Pioneer-authorized Service Department. Other dealers would have to ship it several hundred miles for repairs.

Come, hear.

tech hifi

Quality Components at the Right Price



Hey Boston, You Know Value When You See It!

To tape enthusiasts in 1973, Dokorder was an obscure 8-letter work in a market dominated by 4-letter competitors. 1974 found Dokorder as the "new guy" in Boston audio stores, moving fast to challenge "number one" on the basis of performance and value (not big ad budgets). It's 1975 — year of the Dokorder. Find out why 8-letters are better than 4.

The $400 Bargain

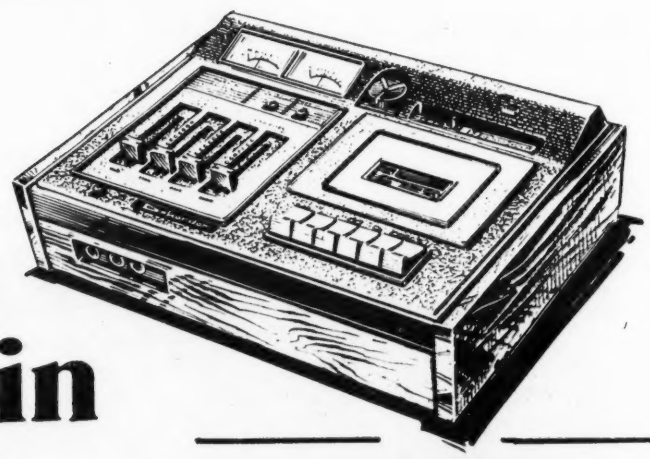
3 Motor Solenoid Transport
Lifetime Guaranteed MBD Heads
30 Hz to 23kHz Response
Built In Special Effects

Dokorder
7100

The $630 Bargain

4 Channel "Multi-Sync" Recording
3 Motor Solenoid; MBD Heads
4 VU Meters; 4 Monitor Controls
"An Outstanding Value" . . . Stereo Review

Dokorder
7140



The $200 Bargain

Dolby B* Noise Reduction
Cue and Review Edit Controls
35Hz to 15kHz Optimum Response
MBD Heads; DC Motor

Dokorder
MK-50

* Dolby is a trademark of Dolby Laboratories.

Dokorder, Inc.

AVAILABLE AT:

Atlantis Sound
All Locations

Audiophile Studio
Newmarket, N. H.
Greenland, N. H.

Bodex Corp.
Marlboro

DeMambro Hi-Fi
Boston

Fitchburg Music
Boston

Images Sight & Sound
Fall River

K & L Sound Service
Watertown

Lieb Electronics
Worcester

Minuteman Radio
Cambridge
Lawrence

Music Alley
Lexington

Nantucket Sound
Hyannis
North Dartmouth

Sound Cellar
Westbrook, Me.

Stereo Places
Providence, R. I.

Stereo Sound
All Locations

Stereo World
Coventry, R. I.

Tech Hi-Fi
All Locations

Hock your jock.
(Or pawn your panties.)

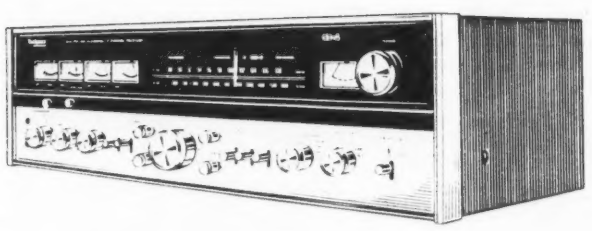
When you go down to your technics dealer and lister to the great four-channel sound they have to offer you'll see what we mean! And Panasonic technics probably cost less then you think. Whether it's the SA-7300X, SA-5400X, SA-8000X, or the SA-6000X we're sure you'll find just what your looking for.

Now Then

How to invest in 4-channel by buying stereo.

Technics by Panasonic
SA-5400X

32-Watt (RMS at 8 ohms) FM/AM 4-Channel/2-Channel Receiver. Discrete 4-channel amplifier. Matrix circuitry. 4-pole MOS FET. BTL circuitry. 2 tape monitors. Mic input. Linear scaled FM dial. Tuning meter. FM stereo indicator. Program selector. Mode selector. 4 separate level controls. Bass and treble controls. Walnut cabinet.



SA-7300X

40 watts RMS (4 x 10W at 8 ohms, all channels driven) FM/AM 4-Channel/2-Channel Receiver. Front panel 2-Channel/4-Channel mode selector. Built-in CD-4 demodulator. Discrete 4-channel amplifier. Automatic separation and carrier level controls. Linear FM/AM dial scales. Automatic speaker protection circuitry. CD-4 Hi-blend switch. 2 matrix circuits. 4 large VU meters. 4 individual volume controls. Master volume control. 2 tape monitors. Speaker output jacks for two 4-channel systems. FM MPX output.

Technics by Panasonic
SA-6000X

56-Watt (RMS at 8 ohms) FM/AM 4-Channel/2-Channel Receiver. Discrete 4-Channel amplifier. Matrix circuitry. AFD control. Phase shift control. Direct coupling. 4-pole MOS FET. BTL (Balanced Transformer Less) circuitry. Linear AM/FM dial. Tuning meter. FM stereo indicator. Program selector. Mode selector. 4 separate level controls. Loudness control. FM muting. Walnut cabinet.

Technics by Panasonic
SA-8000X

64-Watt (RMS at 8 ohms) FM/AM 4-Channel Receiver. Discrete 4-channel amplifier. Built-in discrete record (CD-4) demodulator. Matrix circuitry. AFD control accommodates any matrix records. Phase shift control. 4 VU meters. BTL (Balanced Transformer Less) circuitry. Mic input. Linear scaled AM/FM dial. Program selector. Mode selector. FM stereo indicator. Separate front/rear bass and treble controls. Walnut cabinet.

Technics
by Panasonic

STP

Continued from page 16

of the arm mass/stylus compliance resonance. In other words, instead of an accentuated peak at the deepest bass there is a flattened response, resulting in cleaner, smoother sound. There is also less susceptibility to acoustic feedback (See the article on living with a high-powered amp.)

In short, there is no good reason for not incorporating viscous pivot damping in any tonearm and there are many reasons why damping is highly desirable. As far as commercial tonearms are concerned, there are a few which are damped; most are of British design. The Decca International, Keith-Monks Audio Ltd, and the Transcriptors Fluid are typical examples. In this country, the old Weathers turntable and damped arm is about to reappear under the new name of WIN (no connection with Gerry Ford). To anyone contemplating a high-quality turntable and one of the top high-compliance cartridges, the choice of a damped tonearm is almost mandatory, if ultimate performance is what you're after — or even satisfactory performance with most records containing sustained tones (piano, organ, harpsichord).

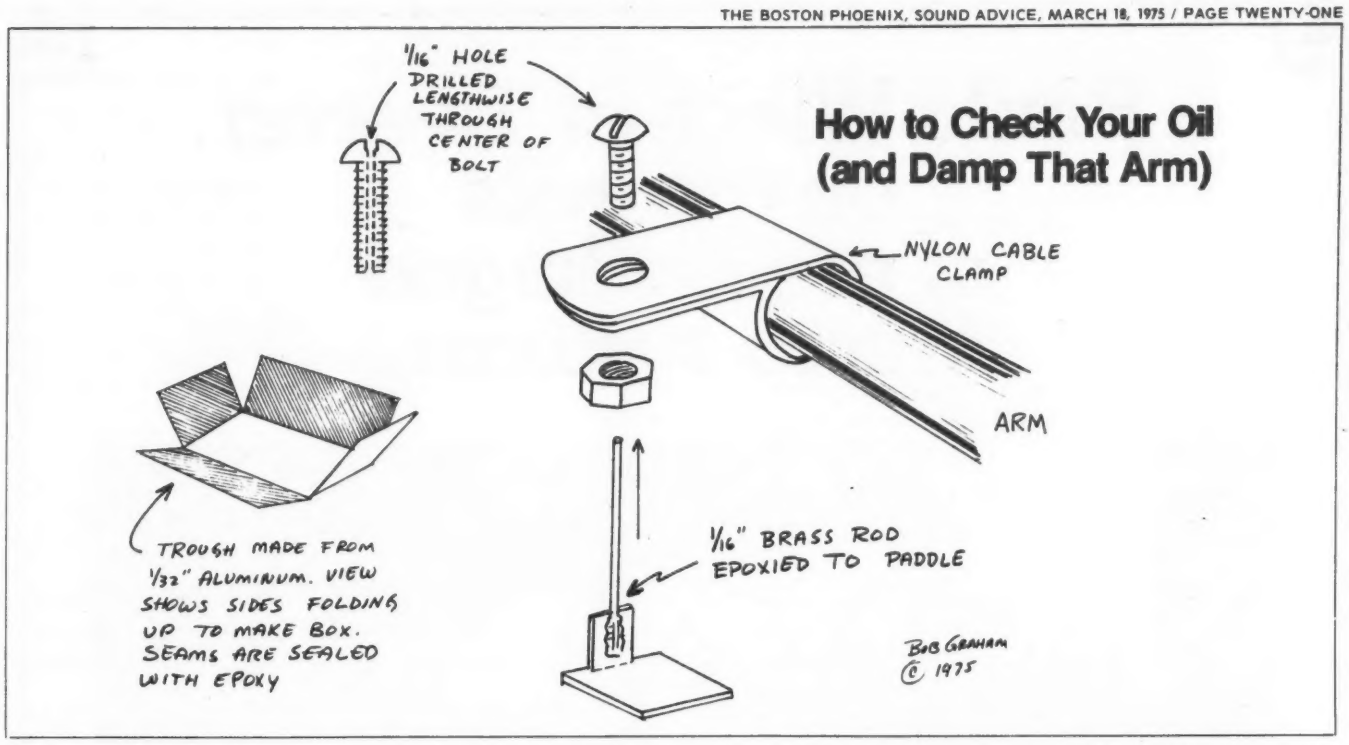
For the majority who are not prepared, however, to scrap their present equipment, there is a way to add viscous damping to one's present arm without resorting to major surgery. The scheme I came up with and have installed on my SME arm is shown in the accompanying illustrations. A piece of thin (1/16") brass rod is fastened to the tonearm, a couple of inches ahead of the pivot. This rod extends downward, and at the end of the rod there is a small L-shaped bracket. This bracket really functions as a paddle assembly to damp vertical and horizontal motion — when it is submerged in a small trough filled with STP oil additive, which, conveniently, is a very thick, gooey substance. The trough is made wide enough to allow the full vertical motion, including the placing of the arm on its rest. (Add about one-half inch extra height so that STP will not spill over the edge if you have to carry the turntable.) The rod should be rigid since the success of this design requires instantaneous response of vertical and horizontal motion to be transmitted to the paddles in the STP, where it will be damped out. The size of the paddles can vary depending on the arm and cartridge in use, but a practical size is for the vertical-direction paddle (the one parallel to the turntable deck) to be about 3/8" square. The horizontal-motion paddle, to which is fastened the brass rod itself, can be less, for its size less critical.

To fasten the rod to the tonearm I used a standard 3/8" nylon cable clamp and fastened the clamp to the arm with a no. 8 nylon nut and bolt. The bolt is drilled through its long axis so that the 1/16" brass rod can be inserted into it. Doing this allows for accurate adjustment of the paddle height and angle, since the horizontal-movement paddle should of course be set so that it's perpendicular to the direction of the arm's horizontal travel. (Incidentally, this addition doesn't affect skating, antiskating, or tracking force settings — simply set all of them as you normally would, after you've rigged it up.)

There may be many other ways to mount these components; I'm just mentioning the one I elected. The only rule to follow in selecting materials and methods of fastening would be to use rigid materials (metal, preferably) and fasten them securely to the arm. The trough I have is simply a piece of thin aluminum which has been folded to make a box. Epoxy was then dripped into the corners to make it leakproof. The paddles likewise were made from thin aluminum and epoxy-fastened to the rod. The nylon hardware can be obtained, if you choose it, from some of the better-equipped electronics supply places.

This is an *extremely* easy thing to make providing one has the availability of proper tools. *Don't* try to bore the small hole in the nylon bolt with a hand drill and vise — it won't work. This can only be done on a machine lathe. (Either find a suitable way to achieve the same result, which is not hard, or you'd be better off having the parts made at a machine shop. There are many such "model" shops listed in the yellow pages that could make the necessary pieces in less than 15 minutes.)

The small amount of effort required to impliment damping in your tonearm will pay large rewards in improved sound (decreased wow and flutter, solider bass, more fixed stereo imaging) from your expensive equipment. A low-mass arm, while highly desirable, is simply not enough. It needs damping. No one who listens on good equipment to any music — especially if it has sustained tones and especially if the pressings are American — should be without it.


How to Check Your Oil (and Damp That Arm)
1/16" HOLE DRILLED LENGTHWISE THROUGH CENTER OF BOLT
NYLON CABLE CLAMP
ARM
TROUGH MADE FROM 1/32" ALUMINUM. VIEW SHOWS SIDES FOLDING UP TO MAKE BOX. SEAMS ARE SEALED WITH EPOXY
1/16" BRASS ROD EPOXIED TO PADDLE
BOB GRAHAM © 1975

KENWOOD
sets the standards.

KENWOOD brings state-of-the-art to a new plateau with the magnificent 700-Series —an advanced frequency-synthesizing tuner, a preamplifier, and an exceptional power amplifier that recreate original sound with lifelike fidelity. Together they cost just under $2,200.

KENWOOD also sets the standards for stereo receivers, four-channel receivers, separate tuners and amplifiers, cassette decks, turntables and speakers in every price range.

For complete information, visit your nearest KENWOOD Dealer, or write . . .

KENWOOD 72-02 51st Avenue, Woodside, New York 11377

Paula Wiech of Tweeter on the evils of pre-packaged stereo systems.

"If you walk into almost any hi-fi store to buy a stereo system, what you'll end up with is a pre-packaged system. It was put together for you before you walked in the door, in other words.

That happens because it's much easier for hi-fi stores to sell systems that way. But it's unfair to the consumer. So we don't sell systems that way at Tweeter.

For example, a couple of weeks ago, I sold a system in the $700 price range to a person who likes to play music very loud. For that reason, I helped her pick out a pair of very efficient speakers. And a receiver with power to spare. The speakers were a pair of Braun 500's. And the receiver was the Pioneer 737. She also wanted a good manual turntable. So I sold her an ARXB.

That system was perfect for her.

But the next person who walks into Tweeter with $700 to spend might have totally different needs. Maybe it will be a person who hardly ever plays records and listens to FM most of the time. In that case, more money should be spent on the tuner and less on the turntable. The possibilities are endless.

So if you come into Tweeter to buy a stereo system from me, I'll sit down with you and we'll discuss your needs. Before I recommend a system."

Tweeter etc.

Harvard Sq., 102 Mt. Auburn St. 492-4411.
Brockton, 849 Belmont St. (Rt. 123 just off Rt. 24) 583-5146. **Chestnut Hill Mall.** 738-4411.
And for amazing deals on demos and the like,
check what's available at **Tweeter's Hi-Fi Outlet**
in the classified section of this paper.

Specs

Continued from page 8

smaller the wave and the faster it can reappear in a given period, the higher the tone sounds (the hum that comes from an open audio line is usually a fairly low 60 Hz, the sound of most alternating current in the U.S. The audible human hearing range is considered to be from 30 Hz to somewhere around 15,000. That's average; high end hearing reduces with age, and few people can hear as high as 18 or 20,000 Hz.)

A **frequency response** curve usually is a plot of the variation in sound level as a given strength input is fed through a component across its frequency range. The differences in output are usually reported as being plus or minus (+/-) a given number of dbs (decibels), which are units of loudness.

Another familiar piece of electronic componentry is a receiver. Basically, a **receiver** is just an integrated amplifier with a built-in "tuner" section. The **tuner** receives radio signals (AM and/or FM). The frequency range of tuners tops out at about 15,000 Hz.

By far, the best known tuner spec is **sensitivity,** usually IHF (Institute of High Fidelity) sensitivity. It is also a most overrated spec. IHF sensitivity is the minimum signal strength (in microvolts) that the tuner can receive with three percent distortion. The catch is that you wouldn't want to listen to that signal anyway. It would be too noisy. Since a mono signal is stronger than a stereo one and the figures are generally given for mono, sensitivity becomes almost a moot point. There are some specs, however, that are quite important and do give you a reasonable approximation of how you can expect a tuner to perform.

Again we come to distortion, and again there is a difference between mono and stereo, with the better figure for mono performance. Capture ratio and selectivity are related criteria. **Capture ratio** is the difference, expressed in dbs, in strength necessary for the tuner to discriminate between two conflicting signals on one frequency. The lower the capture ratio figure, the easier it is for the tuner to choose the desired station.

Selectivity is a tuner's ability to screen out a signal coming from an adjacent channel. It is measured in dbs, too. You want as selective a tuner as you can get, and the higher the figure, the better.

Another important measurement is stereo **separation,** also presented in dbs. It is the difference in volume between a sound that should come *only* from one speaker and the actual sound coming from the opposing speaker. Separation varies with frequency, so that separation at 400 Hz may not be the same figure at 1000 Hz.

All these measurements give you a fairly complete picture of a tuner's performance. No single spec should be used to evaluate the quality of a tuner, or any other component for that matter. But sensitivity is so emphasized by manufacturers and dealers that it is cometimes difficult to avoid judging a tuner on the basis of it alone.

Most people buy a stereo system with some sort of record playing equipment. Whether it's a single-play manual **turntable** or a multiple-play **changer** (which the industry insists on calling an "automatic turntable"), the measurements to look for are really the same. You want a machine that tracks at a low weight, revolves at the

proper speeds and has low rumble.

The capacity to track at low weights is important for two reasons. Most of today's high quality cartridges track at relatively low forces (one-two grams), so that if your turntable has a higher minimum tracking force, you're prevented from using the best cartridges. Second, the lighter the **tracking force,** the longer your records will last. Proper speed really means constant speed. Speed irregularities are generally called wow and flutter. **Wow** is a slow variation, while **flutter** is a fast one. The names derive from the final sound each defect makes. Rumble is a low frequency noise, usually from the motor, that is translated to the arm and then the audio system.

Cartridges, which are the devices used to pick sound out of record grooves and convert the groove undulations to electrical energy, have some of the same parameters as other components. Frequency response and stereo separation are important. As are compliance and tracking force. **Compliance** should be high and tracking force low. Another criterion for cartridge performance is **trackability.** First introduced by Shure, a cartridge manufacturer, a number of years ago, it's a measurement of how well a cartridge can maintain proper tracking and performance on a highly modulated, difficult to track passage. Trackability is used by Shure and other manufacturers — it should be as high as possible.

Tape decks, whether cassette, open reel or cartridge, have some specs in common with turntables. Wow and flutter and speed constancy are very important. (More important, the slower the speed.) Other things to consider in tape units are the overall frequency range and response. Again, that will be better at higher speeds. **Signal-to-noise ratio** is also important. Since in any tape system there is residual noise from the tape iself as well as the machine, the ratio of a given volume signal to the noise level is crucial in total sound performance. The figure is listed in dbs and should be as high as possible. Stereo separation is a factor to consider. You want good left/ right definition over the entire frequency range.

When you get into the area of **loudspeakers,** the concept of measured specs and performance breaks down. The final judge of a loudspeaker is the human ear and the human psyche. Much of music listening is psychological, and that factor is not easily measurable. But what we do know about acoustics and measurements has some relevance. Frequency range and response are also important in speakers. However, the tolerances are considered to be much looser in speakers than in electronic components. While figures of plus or minus a fraction of a db up to two or three dbs are considered acceptable with some electronics, figures as high as five db are considered OK on speakers. Power needed to drive a speaker properly and a speaker's power handling capacity are important too. If a speaker requires 50 watts RMS and all you have is a ten-watt amplifier, you're out of luck. Or, if that speaker can only handle 50 watts and you crank the power up on a 200-watt per channel amplifier, you'll blow it out. Also, the **impedance** or resistance of a speaker comes into the picture. You must know a speaker's impedance and relate it to the amplifier's power output at that impedance.

Speakers are sometimes talked of as "speaker systems." That means they have several speakers or drivers designed to do different tasks. A **woofer** handles the low end with

"When you get into the area of loudspeakers, the concept of measured specs and performance breaks down. The final judge of a loudspeaker is the human ear and the human psyche."

midrange, tweeter and super tweeter taking up the rest of the audio spectrum. The number of different functions is what is referred to by a "three-way" speaker system. It will have one or more woofers, **midranges** and **tweeters.** The electronic circuit that shunts the frequencies around to the different speaker components is called the **crossover** network. And a spec sheet will list at what points the crossover takes place.

Speaker design is an important parameter itself. Today the most popular high-fidelity speaker is probably the **acoustic suspension** type which makes use of a pre-determined amount of air that is enclosed in the cabinet to react to a speaker cone's excursions and to apply the proper counter force. However, the **bass-reflex** type speaker is again becoming popular. Its design rests on the principle of taking the waves that come from the rear of a vibrating speaker cone and bringing them to the outside of the enclosure in order to bolster the sound field. Bass reflex speakers are usually brighter and punchier than similar acoustic suspension types.

Horn speakers, which use a long tube and almost a conch shell effect, are also in use. Generally, they are very large speaker systems. The most famous horn speaker is probably the one on the Victrola that RCA's Nipper is listening to hear "his master's voice." A completely different speaker design is the **electrostatic.** It does not use speaker cones or horns, but rather, two metal plates held apart and electrically charged. As the charge varies, via the amplifier signal, these plates move, creating sound waves the same way that a speaker cone is moved by the same signals and creates sound waves. Electrostatic sqeakers are excellent reproducers of high and midrange frequencies but can be deficient in the deep bass region.

By far, the most important factor in speakers is the area they're placed in. A speaker put in a corner will sound different if you pull it out from that corner by just a foot. The room furnishings also affect the way a speaker sounds. A room that's heavily carpeted, with soft sofas and stuffed easy chairs, will absorb sound and seem "dead" in relation to a room with a bare floor and starker furniture. A speaker must be listened to to be appreciated properly.

While the terms and measurements are very important, the most important thing is to have a stereo system that you can listen to and enjoy over a long period of time. The jargon means nothing without the ability to put it to together in ways that make sense for you. You may not need components with the ultimate specs because your ears and your home (and maybe your wallet) should be the final arbiter of the stereo system you select.

What's the best sound you can get in car stereo?
In its February 1974 issue, Road & Track Magazine gave the answer.
Of 20 units tested they said the Craig Model 3139 Powerplay delivered

"Easily the best sound of any tape unit tested."

Road & Track reported it right—an independent test of 20 tape and radio-tape models from 16 leading manufacturers. Here's what they said about the Craig.

"...with lots of power (more than twice the nearest set among the others) and the corresponding ability to play loudly and clearly. A rather theatrical red light indicates high-volume sound. Tone control linear and effective; full treble doesn't eliminate bass but just seems to let everything out. Easily the best sound of any tape unit tested. Controls are extensive too, with radio pushbuttons, repeat and fast-forward plus the 8-track controls taken for granted."

For test results of all 20 units write to Powerplay Test, Craig Corporation, 921 W. Artesia Blvd., Compton, California 90220.

Hear the Light
CRAIG®
POWERPLAY®
CAR STEREO

Craig Corporation, 921 W. Artesia Blvd., Compton, California 90220
In Canada: Craig Sales Agent—Withers Evans, Ltd., 2736 S.E. Marine Dr., Vancouver 16, Canada.

AVAILABLE AT:

BRAINTREE
The London House of Tapes
BILLERICA
Lafayette Radio
Electronics Associate Store
BOSTON
Cramer/Olson Electronics
BROCKTON
Audio Sound Co., Inc.
Panorama Sales
CAMBRIDGE
Cramer/Olson Electronics
Lechmere Sales
COHASSET
Olde Colony Stereo
DANVERS
Lechmere Sales
DEDHAM
Music Tent
Lechmere Sales
HANOVER
Olde Colony Stereo
Cramer/Olson Electronics
HAVERHILL
Lafayette Radio
Electronics Associate Store
LAWRENCE
A&W Electronics
Malco Electronics
LEOMINSTER
Lafayette Radio
Electronics Associate Store
MARLBORO
City Hall Music
Radio Shack
MEDFIELD
A&D Television
MEDFORD
A&W Electronics
MILFORD
Pagnini's Music Nook
NORWOOD
A&W Electronics
PEABODY
Cramer/Olson Electronics
QUINCY
Jason's Music
READING
Electro-World
SPRINGFIELD
Lechmere Sales
SOUTH NASHUA, N.H.
Lafayette Radio
Electronics Associate Store
WALTHAM
Waltham Camera & Stereo
WELLESLEY
Cramer/Olson Electronics
WEST QUINCY
Olde Colony Store
WINCHESTER
Winchester Music
WORCESTER
Linear Sound

Specs

Continued from page 9

the groove, producing distortion. There are some cartridges which in tests exhibit uniform "channel separation" at all frequencies, and they are among the sweetest-sounding cartridges on the market — not surprising now that we recognize the reported "crosstalk" in other cartridges as distortion. (A "channel-separation" figure of 10db corresponds to 30% distortion, 20db to 10% and 30 db to 3%.)

The common practice of expressing channel separation in decibels is very misleading. Consider two FM stereo tuners, for example. If tuner A has 40 db of stereo separation and tuner B only 30 db, is tuner A significantly better? In most areas of audio, a 10 db change in a parameter has quite obvious results. Certainly a 10 db peak in frequency response is a severe response error; and if an amplifier has a 20-watt rating, then another amplifier 10 db more powerful would put out 200 watts— a large increase. And when a Dolby system improves the signal-to-noise ratio of a cassette recorder by 10 db (from 45 to 55 db), the audible reduction of hiss is substantial. How important, then, is an improvement in stereo separation from 30 db to 40 db? The answer is that this 10 db improvement is trivial, nearly impossible to hear.

The decibel is not a *quantity*. The weight of something is a well-defined quantity, and a pound of iron is as heavy as a pound of feathers. But a decibel is simply a *ratio*, and the audibility of a decibel depends on what quantities are being ratioed. In the case of stereo separation, what is being ratioed is the acoustic or electrical *power* in the two stereo channels when a signal is fed to just one channel. If the measured separation is 10 db, then 10% of the signal power is leaking over to the wrong channel. If the separation is 20 db, then 1% of the power is coming out of the wrong channel. With 30 db of separation the crosstalk leakage is 0.1%, and 40 db means 0.01% cross-channel leakage of power.

Now you can see that increasing the separation from 0 db (monophonic sound) to 10 db can be quite dramatic since it involves cutting the cross-channel power mix from 100% down to 10%. In fact, a stereo separation of 10 db, if maintained over a broad range of frequencies, is quite adequate to establish a plausible stereo image. Further increasing the separation to 20 db (1% leakage) produces a clearly audible, but not dramatic improvement in the auditory focus of the stereo field. Beyond that, further reductions of crosstalk below 1% become increasingly difficult to hear. With good source material the reduction of crosstalk to 0.1% (30 db separation) produces, if you listen carefully, a subtle improvement in the localization of individual instrumental voices within the orchestral mass and a better sense of the depth (as well as breadth) of the stereo image. Reducing the crosstalk still further to 0.01% (40 db) usually has no audible effect.

The most important stereo specification is one that is seldom mentioned: over how broad a frequency range is adequate separation maintained? Separation is usually specified only at one frequency (1000 Hz). Many FM receivers which have impressive separation figures at 1000 Hz exhibit only 10db of separation at the low bass and high treble frequencies, which can cause some ambiguity in the sonic imagery of instruments which produce sound over a wide range of frequencies. A first-class FM tuner has well under 1% of crosstalk (i.e. well over 20 db of stereo separation) up to at least 10 kHz in the treble and down to 100 Hz or lower in the bass — and this is what produces a first-class stereo image, not a 0.01% (40db) midrange crosstalk figure.

Another piece of test data which is widely misunderstood (even by some magazine test report writers) is "quieting." If a test report says that tuner A has a full-quieting figure of 46 db and that tuner B has a maximum quieting of 52 db, does that mean that tuner will sound six db quieter? Absolutely not. Tuner B may even sound noisier than tuner A. How quiet the background hiss of a tuner is is specified not by the quieting, but by the signal-to-noise (S/N) ratio, which is over 60 db in the best tuners.

"Quieting" is a combined measure of the noise plus the distortion in a tuner, and of these the noise plays an important role only on very weak signals. On strong signals the "quieting" is simply a measure of distortion.

In a typical FM tuner the quieting may be 30 db for a signal strength of two microvolts, and here noise dominates the measurements. As the signal strength increases to about 10 or 20 microvolts, the noise rapidly decreases to about 50 db, while the "quieting" curve starts leveling out at around -40 db. On strong signals (say, 1000 microvolts) the noise is down 60 db or more, while the quieting is "only" at -46 db in a typical case. Since the noise is well below the quieting figure, the "maximum quieting" measurement is simply a disguised statement of total harmonic distortion (THD). As there already is an explicit statement of THD in any tuner test, the quieting figure is redundant and should be ignored.

The quieting measurement normally is made using a signal frequency of 400 Hz, so you might still like to convert it to the equivalent THD percentage for comparison with the stated distortion at other frequencies. You can use the following table for this conversion.

0 db	100%
10 db	30%
20 db	10%
30 db	3%
40 db	1%
46 db	0.5%
50 db	0.3%
54 db	0.2%
60 db	0.1%

For another specification oddity, consider the signal-to-noise ratio specified for tape recorders. Is a tape recorder with an advertised S/N of 60 db quieter than one whose S/N is reported to be 55 db? Not necessarily, because S/N ratios come in several flavors. In fact, the odds are that the "60 db" machine actually makes noisier recordings than the "55 db" recorder, because the makers of mediocre machines often select a rating method to give the most impressive-looking number, while the makers of the best machines use a more conservative approach to specifications. So before you can compare the numbers, you first have to get numbers of the same flavor from the different manufacturers.

There are two important variables involved in tape recorder S/N ratios: the level of the signal that the noise is ratioed to, and the type of noise that is measured. Sometimes, the S/N is referred to as a level of 0 VU on the recorder's meters. Ideally, this would always correspond to a standard recorded level on the tape. But in recent years, as a greater variety of machines and tapes have been produced, even the 0 VU level itself has varied from one recorder to the next. Then, regardless of what recorded flux level of "0 VU" mark corresponds to, there often remains some additional head room above 0 VU for peaks before serious distortion sets in. So recorder S/N values may refer to the recording level which would produce 3% distortion; the S/N number then specifies the total dynamic range of the machine.

The noise itself is measured in two ways. If a meter is connected directly to the recorder's outputs, it measures everything coming out, regardless of its audibility. This "unweighted" noise usually consists mostly of hum. But at the low level at which the noise will be reproduced via speakers, the ear is much more sensitive to hiss frequencies than to hum. So, in order to produce a noise measurement which represents the audible noise, the noise may be passed through an "A-weighting" filter whose response simulates that of the ear to weak sounds.

Putting these variables together, a single tape recorder could have four different specified S/N ratios:

52 db (unweighted, re 0 VU);
56 db (weighted, re 0 VU);
60 db (unweighted, re 3% THD);
64 db (weighted, re 3% THD).

If you are going to try to compare S/N ratios for various recorders, you've first got to get numbers of the same flavor. Good luck.

In many respects, specifications and test reports must be used with caution. As precise as the numbers may be, their interpretation is a challenge.

Silence has a bearing.

Glenburn's 2155A automatic turntable exceeds the most demanding stereo standards. Has oversize turntable bearing to reduce wow and flutter and the exclusive Uni-Planar mechanism for smooth, quiet operation. Equipped with Shure M75E magnetic cartridge with elliptical diamond stylus. Features bi-directional viscous-damped pause and cue, viscous descent during automatic play, adjustable anti-skate and stylus pressure, full size turntable with mat, super-light tracking and tripping, walnut grain base and tinted dust cover. 2155S is the same but less base and cover for custom installation.

GLENBURN better by design

Available At:

TECH HI-FI
All Stores (Mass., R.I., Ct., Me., N.H., Vt.)

AUDIONICS
Providence, R.I.

YOU-DO-IT
Needham

LAFAYETTE RADIO ASSOC.
Manchester & Concord, N.H.

K&L SOUND
Watertown

WALTHAM CAMERA
Waltham

DELTA HI-FI
Bristol, R.I.

SOUND-O-RAMA
Cranston, R.I.

ELECTRONIC WORLD
Framingham

HARMONY HUT
Falmouth

AUCLAIR'S
Woonsocket, R.I.

IMAGES SIGHT & SOUND
Fall River

PIRA'S AUDIO
North Dartmouth

STEREO STORE
Fall River

J. TREISMAN
All Stores (N.H.)

Value

Today with everyone looking for value, the question remains: What is a good value? The answer we suggest is the same one we've been offering for years:

The Best Value is represented by the best equipment and services you can buy for the amount of money you want to spend.

Suffolk Audio is always concerned with your needs and we believe we sell audio equipment which represents the best value. We offer the following promises:

1. **Evaluation:** All our equipment has been thoroughly tested by our own staff before we offer it to you. Every piece is measured against the same rigid standards of excellence we would use for our own stereo systems.

2. **Pre-testing:** Each unit is pre-tested and adjusted for maximum performance before it gets to the showroom floor. This is the *only* way you know that you're getting what you paid for.

3. **Extended in-house warranties:** We are a factory authorized service station for nearly all the equipment we sell, and all work is done in our own laboratory. We also extend the manufacturers warranty to further protect your investment.

4. **Knowledge:** We are a group of dedicated professionals with an active interest in audio and an extensive interest in music.

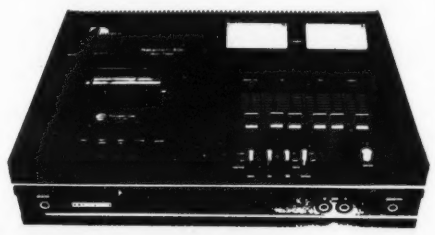
Come in and talk to us, we know you'll hear the difference.

Below are four pieces of equipment which offer extraordinary value in terms of performance and reliability.

NAKAMICHI

Nakamichi 500

The Nakamichi 500 is the only two head cassette deck in the world which will stand direct comparison to the awesome Nakamichi 1000 Tri-Tracer.



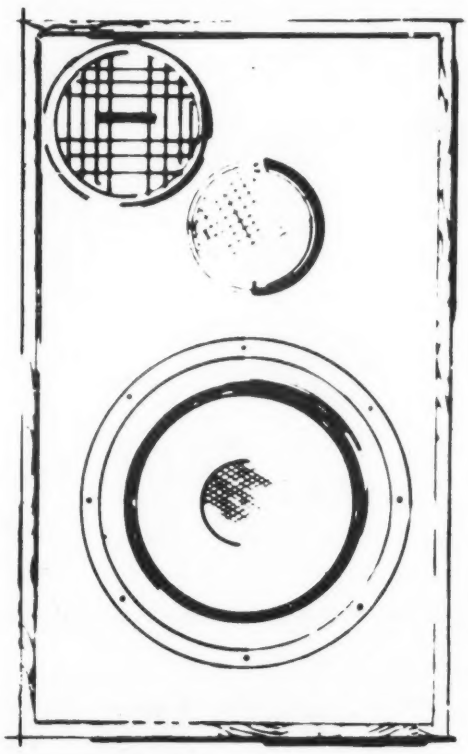
Only Nakamichi could draw on their experience from making the finest cassette machine in the world to produce the best price vs. performance deck on the market. At only $400, the Nakamichi 500 might be the only cassette deck in town.

RSC

RSC PRO 350

The RSC PRO 350 is a sophisticated compact loudspeaker utilizing advanced materials and innovative techniques to achieve two basic goals:

1. The lowest possible coloration (loudspeaker sound)
2. A maximum performance vs. price ratio



After extensive listening tests, we feel the PRO350 establishes a new high standard of performance for inexpensive loudspeakers.

The RSC PRO350 is priced at $203.00 per pair. We urge you to listen to them before you buy any speakers at or near this price.

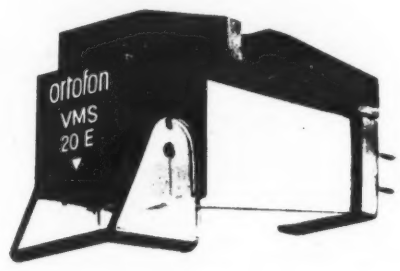
ortofon

ORTHOFON VMS-20E

The ORTOFON VMS-20E is the newest product of a company known throughout the world for phono cartridges of the highest quality.

The new VMS-20E is directly comparable in terms of low distortion and high definition to the highly acclaimed ORTOFON M-15E Super. The principal difference in the cartridge lies in the goals set by ORTOFON at the time of their design. While the M-15E Super is a true "cost no object, no compromise" design, the design goals of the VMS-20E were specifically directed to achieve two important and desirable benefits to the user:

1. An optimum price vs. performance ratio (i.e. value).
2. The ability to work well in a wider variety of tone arms.



The technical specifications of the VMS-20E are impeccable. Sonically, it provides advantages over its competition which are immediately and obviously apparent.

At only $65, the ORTOFON VMS-20E is perhaps the least expensive way to improve an already good music system.

Connoisseur

The Connoisseur BD2 MkIV

The technical performance of this turntable is directly comparable to competitive units selling for three times its modest price. The platter system is superb in terms of wow and flutter and offers one of the best **unweighted** rumble figures to be found anywhere. The

gimbal mounted tonearm incorporates a uniquely simple frictionless anti-skating device and is capable of using the finest cartridges to the fullest advantage.

The price of the Connoisseur BD2, including wooden base and hinging dust cover, is $145.

High performance is the standard

SUFFOLK AUDIO

1105 Mass Ave Cambridge, Mass. 617·868·1080

2 HOURS FREE

FROM maxell®

For A Limited Time MAXWELL Is Offering A Special
3 Unit Package Of LNC-120 And UDC-120 Cassettes.

BUY TWO CASSETTES AND GET ONE FREE!
(Offer Expires April 30, 1975)

LOW NOISE
LN

LN LOW NOISE CASSETTES -
Brothers under the shell - premium features and quality at sensible prices.

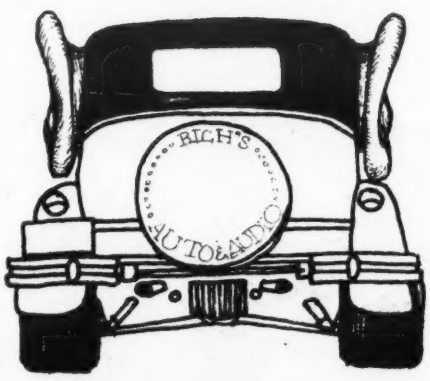
ULTRA DYNAMIC
UD

UD ULTRA DYNAMIC CASSETTES -
High precision shells, high output, low noise and low distortion - clearly the cassette that delivers the goods.

the Coop

MIT STUDENT CENTER — HARVARD SQ. — CHILDREN'S HOSPITAL MEDICAL CENTER

Does Your Car Have Ears?



(treat them to the best)

PIONEER® Panasonic®
CRAIG® Jensen Clarion
SONY® JIL

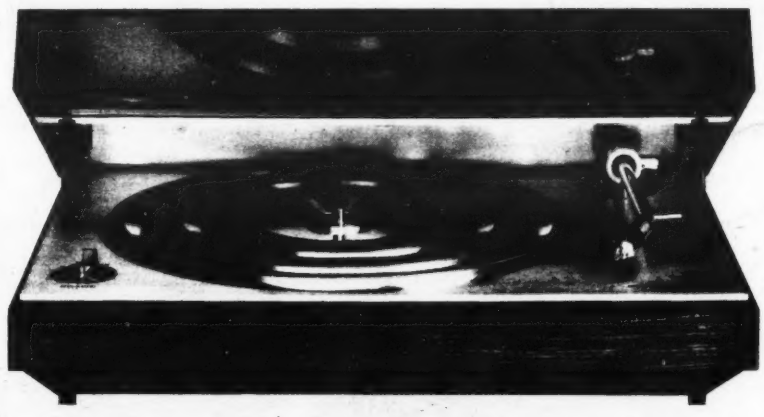
Custom audio design for you & your car's individual tastes.

Clarion 811 Cassette Deck **(List $120)**	PIONEER KP4000 In-Dash AM/FM Stereo Cassette **(list $189.95)**
CRAIG 9427 Speakers **(List $23.95)**	CRAIG 9427 speakers **(List $23.95)**
Plus Installation **($45)**	Plus Installation **($50)**
ONLY $170	**ONLY $225**

ALL INSTALLATION WORK GUARANTEED FOR LIFE OF YOUR CAR

RICH'S AUTO & AUDIO

204 Dexter Ave., Watertown • 923-1490
6 mins. from Harvard Square and 12 Mins. from Downtown Boston
(Behind the carwash, off Arsenal St.)



The Beogram 3000

One part of a system developed to reproduce sound as it is.

The Beogram 3000 is an integrated, automatic turntable offering utter simplicity of operation and elegant, understated design. All functions are handled by a single master control: the choice of record size automatically selects the correct speed (33 or 45 rpm), a slight touch of the center disk places the stylus tip in the first groove of the record. When the selection is completed, the tone arm automatically returns to its rest position and shuts off the unit.

The tone arm pivots on hardened steel bearings for low horizontal friction. An ingenious system of inclined planes automatically applies the correct amount of anti-skating force as the tone arm travels across the record. A pendulum suspension system isolates the stylus from external vibrations and acoustic feedback.

As a turntable must operate in concert with the cartridge, the Beogram 3000 has been engineered to utilize Bang & Olufsen cartridges. The integration of tone arm and cartridge provides a lower dynamic mass, thus reducing the force required to move the stylus tip, and eliminates unwanted resonances. Bang & Olufsen cartridges have been acknowledged as being among the world's finest.

Bang & Olufsen

Excellence in engineering – Elegance in design
Two traditions from Denmark

Available at: TWEETER ETC. (BROOKLINE, CAMBRIDGE, CHESTNUT HILL, BROCKTON); STEREO SOUND (BOSTON, CAMBRIDGE, BURLINGTON); MALCO ELECTRONICS (LAWRENCE); MANCHESTER MUSIC (MANCHESTER, N.H.)

Thanks, Elton.
We think you're fantastic, too.

PIONEER®
when you want something better

Shown: SX-636 receiver, PL-71 turntable, CS-99A speakers, CT-5151 cassette deck, RT-1050 reel deck

U.S. PIONEER ELECTRONICS CORPORATION, 75 Oxford Drive, Moonachie, New Jersey 07074
West: 13300 S. Estrella, Los Angeles 90248 Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007 Canada: S. H. Parker Co.

MASSACHUSETTS

BILLERICA
Lafayette Radio
BOSTON
Atlantis Sound
Copley Camera
Cramer/Olson
DeMambro Electronics
Lafayette Radio
Stereo Sound
Tech Hi Fi
BRAINTREE
Atlantis Sound
BROCKTON
Tweeter, Etc.

BROOKLINE
Tweeter, Etc.
BURLINGTON
Lafayette Radio
Stereo Sound
CAMBRIDGE
Atlantis Sound
Cramer/Olson
Lechmere Sales
Minute Man Radio
Stereo Sound
Tech Hi Fi
Tweeter, Etc.
CHELMSFORD
Radio Shack

CHESTNUT HILL
Tweeter, Etc.
COHASSET
Olde Colony Stereo
DANVERS
Con-Sonics
Lechmere Sales
DEDHAM
Lechmere Sales
Tape Place
Tech Hi Fi
FALMOUTH
Harmony Hut
Ortins
FITCHBURG

Fitchburg Music
FRAMINGHAM
Atlantis Sound
Tech Hi Fi
HANOVER
Cramer/Olson
Olde Colony Stereo
HYANNIS
Draper International
Nantucket Sound
LAWRENCE
Malco Electronics
MALDEN
Sound Enterprises
MEDFORD

A&W Electronics
NANTUCKET
Grey Electronics
NATICK
Lafayette Radio
NEEDHAM
You-Do-It
PEABODY
Atlantis Sound
Cramer/Olson
Lechmere Sales
QUINCY
Olde Colony Stereo
RAYNHAM
David B. Dean Co.

SALEM
Highland Sales
SAUGUS
Lafayette Radio
STONEHAM
Tech Hi Fi
WALTHAM
Tech Hi Fi
Waltham Camera
WELLESLEY
Cramer/Olson
W. BRIDGEWATER
Tape Place II
WEST ROXBURY
Lafayette Radio

WORCESTER
Atlantis Sound
Leib Electronics
Tech Hi Fi

NEW HAMPSHIRE

BOW
Action Audio
CLAREMONT
Radio Shack
DOVER
Radio Shack
Atlantic Hi Fi
HANOVER
Dartmouth Audio
KEENE

Melody Shop
Radio Shack
MANCHESTER
Action Audio
Bi-Rite Mdsers.
Treisman's
NASHUA
Tech Hi Fi
Treisman's
PORTSMOUTH
Radio Shack
Atlantic Hi Fi
ROCHESTER
Action Audio

RHODE ISLAND

BRISTOL
Delta Hi Fi
COVENTRY
Stereo World
CRANSTON
Sound-O-Rama
N. KINGSTON
Stereo World
PROVIDENCE
Atlantis Sound
Lafayette Radio
Stereo Places
Tech Hi Fi
WARWICK
Tech Hi Fi
WOONSOCKET
Ed's TV

B·I·C VENTURI speakers turn low-power amps into tigers, high-power amps into pussycats.

Trying to coax a throaty growl from a little pussycat of an amplifier? Try B·I·C VENTURI™ -- the speaker with exceptionally high efficiency so you get more sound power out of each watt.

Still searching for speakers that can take plenty of power and won't go up in smoke? Again, try B·I·C VENTURI.

Looking for speakers that can reproduce music's full dynamic range so you can hear the loudest louds and softest softs?

B·I·C VENTURI does it all without sacrificing frequency range, accuracy, size or price.

B·I·C VENTURI offers four ways to turn low-power amplifiers into tigers and high-power amps into pussycats: The Formula 2, fills the average room with clean, high level sound from even modestly powered, inexpensive amplifiers. The Formula 4, enhances the performance of low-power amplifiers. It also handles high-power amplifiers effortlessly and flawlessly. The Formula 6 handles up to 125 watts per channel and achieves a quality of sound unrealized from super-power amplifiers. And the newest B·I·C VENTURI, the Formula 1, sounds better than all other speakers of its size and in its under-$75 price class.

Visit your B·I·C VENTURI dealer... and purr. For descriptive brochure write:
British Industries Co., Div. of Avnet, Inc.
Westbury, N.Y. 11590.
Canada: C.W. Pointon, Ont.

BIC VENTURI™

Blazing

Continued from page 3

at a cringingly low level. If you see noticeable cone movement, you have a problem, and whatever component is responsible for it needs service.

Even after you have shot the trouble (as they say) in the rest of your system, you may find your new power amp at fault; some of them emit fearful turn-on or turn-off thumps themselves (generally there's not much to be done about it), and these thumps may slowly soften up your woofers for some final demise. If your amp is a thumper and there's apparently no cure for it, you might ask the friendly store that sold it to you to rig up a speaker in-out switch, so that you can turn on the amp with the speakers out of its circuit and, later, get them off-line before turning it off. Seems like work? Getting speakers fixed is more work.

Another major speaker slayer is acoustic feedback. If your turntable is catching low-frequency vibrations from your speaker it will generously pass them along to your phono cartridge, which will in turn get them amplified and emitted as more sound. The "music" thus goes round and round, but not for long if you have a super amp in the chain. Sometimes in a matter of seconds, the weakest link — your speakers — will break; if you are lucky you'll be able to save them with a dive for the volume control.

This rather athletic approach to control of acoustic feedback can be made unnecessary by placing your turntable on a firm foundation — say anchoring it to a wall, suspending it from the ceiling, or at the very least lifting it off the floor, loudspeaker, shaky table, or whatever you may have it resting on that quivers. Look hard for a firm location; not only will it pay off in longer-lived loudspeakers, but cleaner, firmer bass will be a result, too.

Electrical feedback is even more deadly if only because it is faster. For a hard-knocks lesson in electrical feedback, press a tape-monitor button and feed a recorder's own output back into its input. The lesson will be brief, maybe earshattering. If this doesn't convince you, try putting a connected microphone in front of your speakers and letting them sing to themselves. They will quickly yowl "goodby."

Your tweeters might fry as the result of needle chatter. This is caused by the stylus's rattling around in record grooves at supersonic frequencies, and, unless your equipment is of poor quality and stylus force improperly set as well, it will rarely bother you. But check; your new monster amp will probably put out a kilowatt at 40,000 Hz as quickly as at 1000, and tweeters aren't made to suffer like that, so they die.

Your record player is much more apt to contribute low-frequency junk to the signal. This may be a composite of rumble engraved on your records, rumble from your turntable, and maybe worst of all, oscillations caused by a poorly matched tonearm (massive) and cartridge (high-compliance) playing a warped disc. Most of this stuff is below 20 Hz and thus isn't audible, but your amp will pass it along — well-boosted — to your woofer, which will thank you by expiring if it gets too much.

The problem is made worse by the possibility that your preamp is applying *more than 60 db of boost* to these subsonic garbage signals. Some of the most highly touted preamps do this, because of carelessly designed phono equalization. Is there a cure? Yes, several. Make sure that you have a well-matched tonearm and cartridge — there should be no visible movement of the stylus cantilever relative to the cartridge even when badly warped records are played. If there is, you need either a lighter arm, one with less pivot friction or more pivot damping, or a less-compliant cartridge.

If that doesn't solve your problem, go again to your friendly hi-fi service shop and ask them to build you a "subsonic filter." They will know what you are talking about and maybe a week later give you a tiny box to hook between your preamp and monster power amp which will cut the low-frequency garbage out of the signal so that the monster never sees it. If you suspect needle chatter problems, ask them to add a roll-off above, say, 25,000 Hz too; it won't cost much more. And even if the box sets you back $20 or so, that's less than the usual price of a woofer replacement.

Finally, we come to fuses and limiters. These have been left till now because of their perversity. It is entirely possible (I have done it often) to blow a speaker without harming the fuses carefully placed in the speaker lines to protect them. This isn't to say that you shouldn't use fuses, just don't expect them to work fast enough more than half the time.

Some speakers come already fused — the AR-LST-1, for example — and about these you need not worry further. But if there's no fuse on the back of your speakers, by all means write to the manufacturer and ask him to suggest an appropriate fuse size and type. You can then purchase a holder and install the proper fuse between the monster and your speakers.

Often, though, the proper-size fuse blows for no good reason, and does so repeatedly. What then?

Try FNM-series fuses of the same or one-half-amp smaller rating. These take longer to blow, although giving essentially the same protection as other fuses. Acoustic Research supplies them for use on its speakers; you may be able to buy them, too, from an AR dealer. If your local sources are snotty about it, order these small cartridge-style fuses from the Bussmann Mfg. Div., The Mcgraw-Edison Co., St. Louis, Mo. 63107. They're called "Fusetron, dual-element fuses."

As for limiters, don't bother. Robins sells a speaker protection box that limits power going to your speaker to a set level, but while the box works as advertised, there's really no reason to use it if you want your super-amp to do what it is supposed to do — namely, supply energy for those huge levels and big peaks.

"[A major] speaker slayer is acoustic feedback. If your turntable is catching low-frequency vibrations from your speaker, it will pass them along to your phono cartridge, which will get them amplified and emitted as more sound. The 'music' thus goes round and round, but not for long, if you have a super amp in the chain. Sometimes, in a matter of seconds, the weakest link—your speakers—will break."

Home on the Dynamic Range

By Larry Blakely

In concert the sound level of a symphony orchestra's very loudest fortissimos may be as much as 80 db above the level of its quietest passages. This difference between the loudest and quietest sound levels of the music is called dynamic range. *Ideally*, to record and reproduce the sound of live music accurately without adding noise or distortion, the recording medium should accommodate the full dynamic range of the music (plus a safety margin of at least an additional 10 db) between the inherent background noise level of the equipment and the peak signal level at which distortion becomes audible.

Unfortunately, even the best professional studio tape recorders are capable of only a 68 db dynamic range at a tape speed of 15 inches per second. Even this is at a peak signal level which causes three percent harmonic distortion (which is audible). To prevent audible distortion, the highest signal level recorded on the studio master tape should have a safety margin of five to 10 db below the three-percent distortion level. This reduces the usable dynamic range to only 55 or 60 db. The tape recorder is thus required to record a musical program with a dynamic range in db of nearly twice its own capability.

If music with an 80 db dynamic range is recorded on a 60 db dynamic range tape recorder, either the top 20 db of the music will be distorted, or the bottom 20 db of the music will be buried in the tape noise, or there will be a compromise of the two.

The recording industry's traditional solution to this problem has been to reduce greatly the dynamic content of the music during recording so that its dynamic range falls within the capabilities of the tape recorder, permitting quiet sounds to be recorded above the tape noise level, while recording loud sounds at levels on the tape which are only slightly (although audibly) distorted.

The dynamic range of a program can be intentionally reduced in several different ways. The conductor can instruct the orchestra not to play too loudly or too quietly and thus produce a limited dynamic range for the studio microphones to pick up. This is often done to some degree, but a reduction of 20 to 30 db cannot be achieved without overly restricting the musicians, resulting in artistically poor performances.

A more common method of reducing the dynamic range is for the recording engineer to modify the dynamic range of the signals picked up by the microphones through the use of manual and automatic gain controls. The manual gain controls are the "faders" or volume controls on the recording studio control console which determine the level of the signals recorded on the tape. If the recording engineer knows in advance from studying his score that a quiet passage is coming, he slowly increases the gain as the passage approaches to prevent its being recorded below the level of the tape noise. If he knows that a loud passage is coming, he slowly reduces the gain as the passage approaches to prevent its overloading the tape and causing severe distortion. By "gain riding" in this manner, the engineer can make substantial gain changes without the average listener's perceiving them as such. As the dynamic range is reduced by this technique, however, the recording will not have the dynamics and excitement of the original live performance. A critical listener will notice this deficiency.

The automatic gain controls consist of electronic signal processing circuits called compressors and limiters, which modify the signal level recorded on tape from the signal levels picked up by the microphones. A compressor reduces the dynamic range in a gradual manner by gently reducing the gain of an amplifier in the presence of loud signals and/or increasing its gain in the presence of quiet signals. A limiter acts more drastically to cut off any loud signal that exceeds some preset leevel. This prevents distortion from overloading of the tape on program peaks.

Another dynamic range modifier is the magnetic tape medium itself. When tape is overdriven into saturation by high-level signals, it tends to round off the peaks of the signals and acts as its own limiter by restricting high level peak signal excursions. This causes some distortion but it is a much gentler, more tolerable variety than the harsh, grating sound of amplifier overload distortion, so the recording engineer permits a certain amount of it to occur to keep the recorded signal as high above the tape noise level as possible and thus obtain a quieter recording. Tape saturation results in the loss of the sharp edge of percussive attacks, a softening of the strong, biting overtone on instruments, and a loss of definition in loud passages when many instruments are playing together.

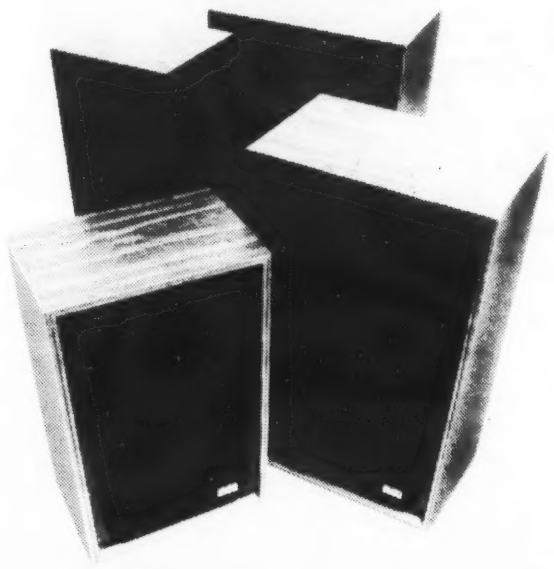
The result of these various forms of dynamic range reduction through signal "tampering" is that, while the basic sounds produced by the orchestra are recorded on tape above the noise level and without severe distortion, the sounds are displaced from their original dynamic relationship. Crescendos and loudness variations have been reduced in scale, and the presence and excitement of the performance have also been compromised.

While popular music as written usually requires a narrower dynamic range than symphonic music, actual performances often produce a wider dynamic range due to the use of amplified instruments. Sound levels at rock performances frequently exceed 115 db. These high signal levels plus the widespread use of 16 or more tracks of tape for pop recording contribute dynamic range problems just as great as those experienced in recording classical music. When 16 tracks of tape are mixed together, the additive tape noise increases by 12 db, reducing the usable dynamic range of the recorder from 60 db to 48 db. As a result, the pop recording engineer strives to record each track at as high a level as possible to minimize the effects of the noise buildup.

To achieve this, limiting and compression are often used on individual microphones during recording. When the 16 or more tracks are mixed into mono, stereo, or quad formats, additional limiting, compression and gain riding are often performed on individual tracks prior to combining them with the others, as well as on the mix as a whole. In the studio, the use of professional tape noise reduction systems on the individual tracks of the 16-track master and on the mixdown tape alleviates the need to restrict the dynamic range of the program at this point to prevent tape noise buildup.

Even if the finished master tape recording does have a huge dynamic range, the music must ultimately be transferred to a conventional disc which has, at best, a 65 db dynamic range. Thus, we still have the problem of a musical dynamic range far too great for the recording medium, requiring a considerable reduction in dynamic range to produce a commercially acceptable

Continued on page 34



Before we started making speakers, we made something else.

A commitment

The most acclaimed new line of speaker systems on the market today didn't get there by accident.

At Avid, we're totally dedicated to just one thing and one thing only: the design and construction of the cleanest-sounding, most accurate speakers in their price range. Each and every one.

And that's not just so much advertisingese. It's for real. And we're not the only ones who think so.

"A BEST IN ITS CLASS . . ."
High Fidelity–August, 1974/Avid 100.

"EXTREMELY SMOOTH AND NEUTRAL . . ."
Len Feldman, FM Guide–December, 1974/Avid 102.

"UTTER SMOOTHNESS AND FREEDOM FROM UNDUE EMPHASIS OR COLORATION . . ."
Julian Hirsch, Stereo Review–April, 1974/Avid 103.

"ONE OF THE MORE SENSATIONAL HIGH-FIDELITY BUYS OF OUR TIME . . ."
Modern Hi-Fi & Stereo Guide–November, 1974/Avid 60.

But it's not what we think, or even what the critics think, that's important. It's what you think.

Listen to an Avid speaker for yourself, today.

AVID® CORPORATION
10 Tripps Lane / East Prov., R.I. 02914

AVAILABLE AT: ☐ **All Lechmere Stores:** Cambridge, Dedham, Danvers, Springfield, MA. ☐ **Fred Locke Stereo:** Springfield, MA. ☐ **Malco Electronics:** Lawrence, MA. ☐ **Images, Sight & Sound:** Fall River, MA. ☐ **All Stereo Sound Stores,** Cambridge, Burlington, Boston.

Power

Continued from page 1

90 db in the home. (A speaker that needs 80 watts to produce an SPL of 100 db will produce 90 db with only eight watts.) So if you want to produce loudness levels of 100 db and up, be prepared to pay for amplifier power or choose a relatively efficient speaker. But high efficiency isn't free either: according to the laws of physics, to increase efficiency in a conventional loudspeaker a designer must either increase the size of the cabinet (which raises cost) or sacrifice deep-bass response, so in the class of compact speakers you have to choose between efficiency and deepest bass.

3) **Your listening room.** Speaker power requirements such as those mentioned above are usually calculated for a listening room of average acoustic "liveness" with a volume of about 2500 cubic feet. A room of twice that volume would double the power requirement (or reduce the maximum undistorted sound level by three decibels). Also, the presence of a great deal of sound-absorbing material in the room (stuffed furniture, people, deep rugs, acoustic-tile ceiling) may reduce the sound level by 1 to 2 db, requiring 50 percent more power to restore the level. Dealer showrooms, with wall-to-wall speakers, are very absorbent and often require twice as much power as you would need at home to achieve a satisfactory sound level.

So far we have mentioned three considerations that affect your amplifier power "needs": the loudness you want when you play music at home, the efficiency of your speakers, and the size and character of your room.

After specifying these parameters, one could calculate with fair accuracy the maximum sustained ("continuous") amplifier power required to deliver the desired sound level. But that would not be adequate, unless you listen to only organ music. Most music is not smoothly continuous and sustained. Generally in live music, the beginning of each note produces a momentary peak acoustic power level much higher than the remaining sustained level of the note. This is most obviously true of plucked and percussion instruments (drum, piano, harpsichord, guitar), but it is also true of nearly all instruments and ensembles. Much of the "life" of live music comes from these attack transients, which don't last long enough to be perceived as "loud"; their reproduction contributes a degree of realism, vividness, and impact which can be more exciting than sheer loudness. So we have a fourth parameter that determines how much amplifier power you need:

4) **The overload margin.** How much overload margin (reserve power for momentary signal peaks) you need depends in turn

Continued on page 32

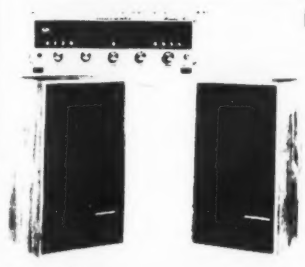
Olson CRAMER
affiliated with Olson Electronics

Just Say "Charge It" master charge MERICARD

ST. PATRICK'S DAY SALE

SALE PRICES GOOD THRU 3/21/75

marantz



Model 2220B Stereo Receiver
$419.85
•20 Watts RMS
•Phase Lock Loop Multiplex

BSR
PRICED SEP.
$59.95
Less Changer

$399.99
Less Changer

8" 2-Way 4G

Model 2260X

BSR 2260X Reg. $54.95 w/base, DC, Cartridge This Week $29.95 when purchased etc.

With the Marantz System

~~4.95~~
NEW

Watts
"Preener" Record Purifier $2.99
•Keeps Your Records Like New!

SANYO

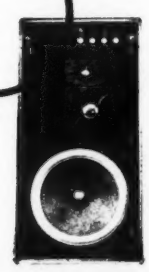
SALE
39.95
~~44.95~~
•AC-DC Operation
•Pause Control
•Built-in Condenser MIC
•M2213

Jetco
TREASURE FINDER

•Solid-state circuits
•Light-weight Portable
•Built in speaker for audible indication
Spots A Penny To 5
$29.99
MUSTANG "330" XX-130

We Take Trade-Ins
REPAIRS Fast, Professional Service
DOWNTOWN BOSTON 817 Boylston St. (617) 267-4700
OLSON STORE In Cambridge 52 Brattle St. (617) 864-4731

INVISIBLE SOUND



For the first time in your life, you can hear music precisely as it was recorded.

Until now, the very best high fidelity loudspeakers have been described as transparent. ADS has taken a giant step beyond transparency – all the way to Invisible Sound.

Music passes through ADS and BRAUN speakers with such natural clarity the speakers seem to disappear. Once you experience the ear-opening sound of live-quality music in your own living room, you'll never be satisfied with conventional speakers again.

The Invisible Sound of ADS and BRAUN emanates from the genius of their chief designer, Franz Petrik – whose ears, by the way, are insured by Lloyd's of London.

Franz Petrik has developed a 1-inch soft-dome tweeter so light it behaves like it has no mass at all. He's designed a 2-inch midrange dome with such wide dispersion it radiates nine times as much power as a conventional cone driver of the same area. He's come up with a revolutionary new sealing fluid which damps the dome drivers so well they have amplifier-like ultra-low distortion. And he's responsible for an exclusive woofer cone compound that is rigid at low frequencies and self-damping at high frequencies.

These are a few examples of the kind of innovative design and precision engineering which make the ideal invisibility of ADS and BRAUN sound a reality.

We'll be happy to demonstrate the complete line of ADS speakers to you. Prepare yourself for a unique listening experience.

(dealer imprint)

THE SOUND OF ADS AND BRAUN

CONNECTICUT

Audiocom
177 Sound Beach Avenue
Old Greenwich
203-637-3621

David Dean Smith
252 Elm Street
New Haven
203-777-2311

David Dean Smith
2348 Whitney Avenue
Hamden
203-281-3761

Hi/Fi Stereo House
9 East Cedar Street
Newington
203-666-4740

Stereo One, Inc.
1229 Post Road
Fairfield
203-255-5939

MAINE

Stombell
180 Lisbon Street
Lewiston
207-782-7331

Stombell
106 Middle Street
Portland
207-773-7403

MASSACHUSETTS

High Fidelity House
261 Park Avenue
Worcester
617-799-9737

Stereo Sound
468 Commonwealth Avenue
Boston
617-261-1155

Stereo Sound
160 Cambridge Street
Burlington
617-273-1105

Stereo Sound
16 Eliot Street
Cambridge
617-864-1155

Sulloth Audio
1105 Massachusetts Avenue
Cambridge
617-868-1080

Tri Pod Audio
98 North Pleasant Street
Amherst
413-256-6985

Tri Pod Audio
219 Main Street
Northampton
413-584-6040

Tweeter, Etc.
849 Belmont Street
Brockton
617-583-5146

Tweeter, Etc.
163 Amory Street
Brookline
617-731-5300

Tweeter, Etc.
102 Mount Auburn Street
Cambridge
617-492-4411

Tweeter, Etc.
The Mall
Chestnut Hill
617-965-3345

Waltham Camera
363-7 Moody Street
Waltham
617-894-9300

NEW HAMPSHIRE

Manchester Music Audio Center
968 Elm Street
Manchester
603-623-3536

Soundsmith
242 State Street
Portsmouth
603-436-9666

Your Usual Listening Level

Few people are aware of their preferred listening level in db, but anyone can determine this for himself or herself by borrowing a sound level meter or visiting an audio dealer's showroom which has one. The Scott Instrument sound meter at around $100 or the Radio Shack unit for half that (see accompanying article) will do very nicely. Check your preferred listening levels on all types of music you are interested in and take measurements at the highest levels you are likely to listen to.

You will probably be surprised to learn of the high sound level at which you like to listen. There have been upward shifts in people's habitual listening levels with the passage of time, and these shifts have had a dramatic effect on equipment power requirements. About 25 years ago, the BBC made extensive surveys which showed that musicians and sound engineers preferred to listen to recorded music at around 88 db, while the general public preferred theirs at around 78 db — a whole 10 db quieter.

Two things have happened since then to raise the listening levels. One is that the "noise floor" has been raised. That is the irreducible minimum background noise which is with us all the time and which we can't get rid of. It has increased steadily over the years. The background noise level in a Boston or Cambridge living room will probably measure some 55 db before the audio rig is even turned on, while a rural home may be able to achieve 45 db (which sounds quiet!) if it isn't near a major highway. The result of this is that you have to play your system louder these days just to get above the background noise.

The other thing which has raised listening levels is rock. Those attend rock concerts have become accustomed to sound levels in excess of 120 db near the bandstand, and one major event, "California Jam," treated its listeners to a sound level of 105 db a full half-mile from the bandstand. At one of the last rock concerts staged at the Fillmore East, readings of 115 db were taken at the foyer doors leading into the auditorium

The result of all this high-sound-level listening is that many fans expect to go back home, put on their latest albums, crank up the stereo rig and hear that same 115-125 db or as close to it as equipment capability and neighbors' tolerance permits.

At this point it's necessary to indulge in a side trip into db sound levels as read on a sound level meter. The readings taken on a sound level meter give you an average level only. The mechanical action of the meter movement and the electrical damping imposed by the meter circuitry effectively ignore the audio peaks in the signal being measured. This causes the readings to be deceptively low by a significant amount. The operative factor here is the peak-to-average ratio of the signal; it is expressed as the number of db by which the peak signal exceeds the average signal level as read on a meter.

There is nothing misleading going on here. Sound level meters are sold primarily for checking noise levels in employment locations which might be hazardous to human hearing. For this purpose it is the average level which is important, not the peaks. In determining the performance we are going to require of audio systems, however, it is necessary to speak of the peak levels the system will be called upon to reproduce, because that's where the system is most likely to clip, distort or otherwise misbehave. The peak-to-average ratio of recorded rock or pop music is likely to be 10 to 12 db. The ratio for most classical recordings will fall between 12 and 18 db. The peak-to-average ratio of uncompressed and unlimited recordings such as dbx-encoded and Sheffield discs, Ambiphon tapes and others can exceed 24 db. The significance of these ratios is that to reproduce these types of music without losing the peaks, your audio system must be able to generate a sound level equal to the average level you have selected as desirable using a sound level meter, *plus* the peak-to-average ratio of the type of recorded music you listen to most of the time.

—Bruce Mallion

And here's a table of sound levels for typical sources:

140 db —707 aircraft take-off fairly close up
130 —Pneumatic hammer at point blank range
115-120—Orchestra and organ at *ffff*, very close
105-110—Open grand piano at microphone distance
100 —Inside moving New York subway car
90 —Freeway traffic at 25 feet
80 —Shouted conversation at 3 feet
70 —Downtown business office
60 —Normal conversation at 3 feet
50 —Quiet city living room
40 —Rural living room
30 —Professional recording studio
20 —Open field in the country at night, no insects, no wind
10-15 —Threshhold of hearing

—David Moran

Sally, where do you find down-to-earth bargains these days? I can't seem to find any at all!
Cindy, you obviously haven't been to Zayre lately! The bargains there are always great and the selection's terrific, too!

ZAYRE
The Discount Department Store

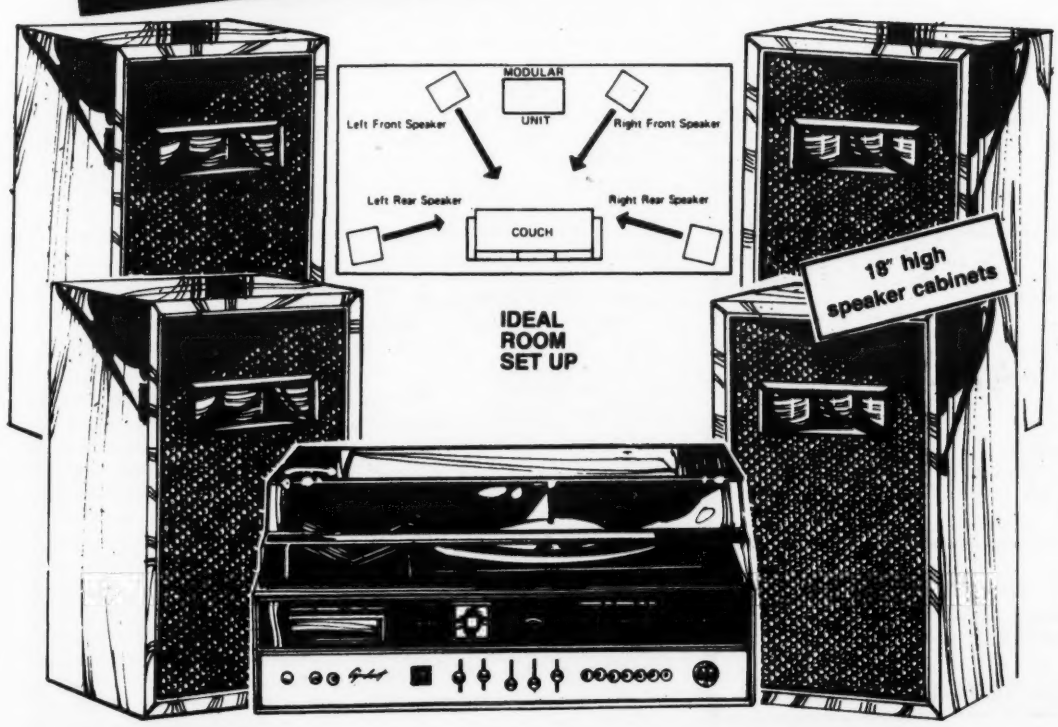
and now for your listening pleasure...

Capehart 12-pc. stereo home entertainment center

139.99 charge it

A complete home entertainment center to delight the family! Includes am/fm stereo radio with lighted blackout dial, matrix switch for 4-channel sound, 8-track tape player, changer with dust cover and tape storage rack. Bonus package includes headphones, deluxe roll-about stand, 3 LP's and 3 tapes!

WHY PAY SKY-HIGH PRICES? SEE OUR QUALITY *Capehart* STEREOS!



save $50

Capehart quadraphonic stereo sound system

199.99 originally 249.99 charge it

The best in stereo entertainment! Deluxe system featuring discrete 8-track palyer, am/fm/fm stereo radio and quality phono with matrix decoder that's compatible with all systems. 4 air suspension speakers with exponential horns and crossover network.

FULL SERVICE GUARANTEE

Zayre and manufacturer stand behind every purchase. 90 day service on stereos.* *Includes repair or replacement of any parts proven defective under normal use. No extra charge for labor.

compare...you can't do better than Zayre

Sale in effect thru this weekend.

BEVERLY	LOWELL	HANOVER *	SAUGUS *	CAMBRIDGE *	BRAINTREE
MEDFORD	ROXBURY	WALTHAM *	REVERE *	NO. READING *	BROCKTON
NATICK	HAVERHILL	WOBURN *	METHUEN *	QUINTREE *	HYANNIS ROSLINDALE

OPEN DAILY 10 AM - 10 PM. *AUTO SERVICE STORE MANCHESTER, BRAINTREE, QUINTREE. BROCKTON, ROSLINDALE, HYANNIS,

Power

Continued from page 30

on three factors — (a) the peak-to-average ratio of the music which you will play, (b) your sensitivity to amplifier clipping, and (c) the overload behavior of your amplifier.

(a) How much stronger are the attack transients than the sustained levels of the notes? It depends to some extent on the music: a concerto by Stravinsky is generally more spiky than one by Brahms, a snare drum riff more than a legato violin line. It also depends on your signal source. Peak-to-average ratios in excess of 20 decibels have been measured in live music; such transients would require a hundred times more power than the sustained levels.

But few of us play original master tapes and no one has his or her stereo system wired directly to microphones. We get our music from commercial recordings and from broadcasts, which are almost universally subject to "limiting" processes. The better records, and live-music broadcasts, exhibit peak/average ratios of 15 db, requiring 30 times the average power to reproduce transients accurately. When records are played on the radio, the broadcast limiting is added to the limiting in the record, typically reducing the peak/average ratio to 10 db, which by a numerical coincidence is a factor of 10 in power. (Low-fi media such as 45 rpm pop records and AM radio exhibit even smaller ratios.) In general the average records, tapes, and broadcasts for home consumption require an overload margin of 10; the best records and "live" broadcasts require an overload margin of 30, with live sound increasing this even more.

(b) If you are playing music requiring sustained five-watt (loud with any speaker) levels, a 15 db attack transient will require 150 watts of momentary power. A 40-watt amplifier will clip off the signal peak, and the distortion is audible though usually not annoyingly obtrusive. If the clipping lasts only a thousandth of a second or so, then the audible effect is not harshness or raspiness; the distortion is perceived as a loss of impact and clarity in the sound, noticeable by comparison with the undistorted sound. If your speakers are good enough you may hear a click at the onset of those transients that cause the amplifier to clip. If the clipping is mainly at low frequencies the bass will become somewhat boomy. How much reserve power you need in your amplifier evidently depends on how sensitive you are to these mild distortions.

(c) The overload behavior of amplifiers is one of the most subtle and little-discussed subjects in high fidelity, and it will occupy most of the remainder of this article. We have been considering how much power you need for satisfactory reproduction of music. Underlying this inquiry is the assumption that "the more power the better," since it is often found that higher-powered amplifiers sound better than lower-powered ones even when operated at low average power levels. But this general rule does not alway apply, and there can be reasons (besides the strain on your bank account) for preferring a medium-power amplifier.

The usual explanation for the audible superiority of a higher-powered amplifier is that it has greater reserve power to handle momentary signal peaks involving five to 50 times the average power; these transients carry much of the "life" and impact of live music. Unfortunately, some high-powered amplifiers are not able to reproduce these musical peaks better than amps of lower power rating. To see how this could be so we shall have to examine some differences in amplifier circuitry.

"How much overload margin (reserve power for momentary signal peaks) you need depends on three factors: the peak-to-average ratio of the music you play, your sensitivity to amplifier clipping and the overload behavior of your amp."

Amplifier anatomy. A complete amplifier is divisible into two major parts: the preamplifier and the power amplifier. The preamplifier contains the volume, tone, and other front-panel controls, and will not be discussed further here. The power amplifier contains the power supply and two (or four if quadriphonic) amplifier channels. Each channel has two stages: the driver stage and the output stage. The driver stage builds up the audio signal voltage, from the one volt or so delivered by the preamp up to a level of perhaps 10 volts for a 10-watt amp or up to 50 or 100 volts for a 500-watt amplifier. The output stage operates as an impedance converter, as the power transistors can carry the high currents required to deliver power to a load (speaker) impedance of only 4 or 8 ohms. Effectively, the driver stage provides a control signal, and the output stage acts as a valve passing current (on command) from the power supply through the output transistors to the speaker.

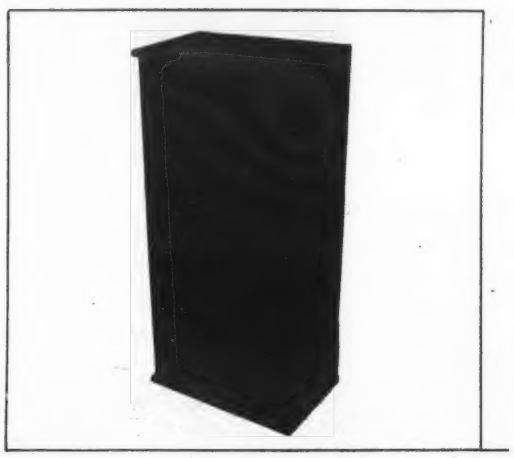
The power supply draws AC power from the wall, filters it, and stores it up in order to be able to deliver current to the speaker on demand, as well as supplying operating voltages for the driver and output stages. Now suppose that a loud musical climax causes current to be drained from the power supply faster than the supply is refilled by filtered power from the wall. The drainage will cause the supply voltages to drop, and this causes distortion in the driver stage. Some designers have attacked this problem by using a fully "regulated" power supply which maintains all voltages constant regardless of current drain. This is elegant, but it is uneconomical — for two reasons. First, full regulation is expensive. Second, with full regulation, the amplifier's continuous power output capability is equal to its momentary power capability. This looks good on paper, but music often has momentary peaks much higher than the sustained levels. You would have to keep the sustained levels in your music well below the amp's continuous-power rating in order to avoid severe peak-clipping. Thus you could not fully exploit the amplifier's rated continuous power. A better solution is for the designer to leave the power supply for the output stage unregulated (thus permitting momentary levels much higher than the continuous-power rating), but regulate that portion of the power supply which provides voltage for the driver stage. With this design the amp's full continuous-power capability can be used, with an overload margin available for peaks.

Thus it is that a 40-watt amplifier with a mostly unregulated supply may have greater reserve power for musical transients (and so may be played louder without audible distortion) than a more expensive, fully regulated 60-watt amplifier. Analogously, amps of similar continuous-power rating may differ considerably in their momentary peak-power capabilities. This distinction was supposed to be accounted for by the IHF "music power" method of rating amplifiers, but IHF ratings have been so widely abused that they no longer provide useful information. And this is just one of several areas of circuit design which can lead to a "higher-powered" amplifier's being less desirable than a "lower-powered" one.

As another example, consider the problem of output stage protection circuits. In the good old days, there was always an output transformer between the output tubes and the speaker terminals, so that a defect or failure in the amplifier might damage circuit parts but the speaker was safely isolated from circuit failures by the transformer. Transistor design successfully eliminated the output transformer, and that improvement brought with it the possibility that the speaker, now directly connected to the output stage, is vulnerable if the circuit goes awry. If a short circuit occurs in an output transistor or an output coupling capacitor, the full power-supply DC current will be fed to the speaker, destroying it. Transistors themselves are also more easily damaged than tubes, so whereas formerly a breakdown might require replacing one tube and a cathode resistor, now an output stage breakdown may burn out six transistors and a dozen associated parts. Fortu-

Continued on page 35

Disappearing Act



Listen to your favorite record on the new Ambient Mod. 55 loudspeaker and you'll hear the speakers almost disappear. All that's left is the music.

You've heard all the words before — transient response, dispersion, low distortion frequency response, etc. But you can't describe a loudspeaker with specs. Listening to music is what counts and the Ambient 55's incredibly detailed, natural musical reproduction is what makes it an outstanding performer and an outstanding value.

Listen to the Ambient 55 and hear it disappear. . .

The Ambient Mod 55 can be heard at
The following authorized dealers in the Boston Area

Suffolk Audio **DeMambro HiFi**

KOSS stereophones **$5.00 ABOVE DEALER KOST**

The Famous PRO/4AA
The Best Selling Headphone In Hi-Fi History Now Has The Best Price In Hi-Fi History
List $65.00
Our Price 44.00
Save 21.00

THE INCOMPARABLE HV/1A AND HV/1LC
HIGH VELOCITY DECLITE PERFORMANCE
These state-of-the-art transducers reproduce all ten audible octaves for a dramatic realism never before achieved with lightweight, hear-thru Stereophones
HV1A: List $49.95 Our Price 34.95
HV1LC: List 54.95 Our Price 37.97

March Special: Call For **UNBEATABLE** Price on J.B.L. 100's
Not only do we have the finest deals on hifi equipment, but our expert technicians with over 12 years experience repair over 100 brands of stereo gear.

NEVER AN ESTIMATE CHARGE • REASONABLE RATES

If you Are Having Any Problems With
Your Present Stereo Equipment And Would
Like Some Advice Call Mike, Norman or Randy
And We'll Help You As Much As Humanly Possible.

AUDIO STUDIO
17 BAY STATE ROAD
BOSTON, MASS. 02215
PHONE: 267-9653
1 block from Kenmore Square
Opp. B.U. Myles Standish Hall

Made in Japan.

During the past three decades, the consummate skill and precision of Japanese technology has become unquestionably recognized throughout the world. Some of the finest values in cameras, cars, motorcycles, appliances, computers and a myriad of other sophisticated products that now contribute to the pleasure of western culture come to us through the accomplished hands of the eastern craftsman. Today, "Made in Japan" means "Made with pride." □ In that tradition, Nikko Electric Corporation has used its 40 years of experience in electronic research and development to create the finest values in home music equipment available anywhere — the all-new line of Nikko receivers, tuners and amplifiers. Here the very latest advancements in solid state of the art have been carefully combined to deliver more sound, more features and more quality for the dollar than ever before possible. □ Before you choose your next music system, make sure you're getting all the performance your money can buy. Listen to Nikko. Proudly made in Japan to bring you the sound of pure value.

Write to us for literature:
NIKKO Electric Corp. of America
16270 Raymer Street, Van Nuys, CA 91406;

The Nikko STA-9090 stereo receiver. It offers a full complement of sophisticated features designed to satisfy the most demanding listener. See your Nikko dealer for power output and other specifications. Suggested retail price: $499.95.

©1974 Nikko Electric Corporation of America

Eastern values for western living.

NIKKO

ADUIOCOM
Old Greenwich, Conn.
ADUIONICS INC.
Providence, R.I.
AUDIO LAB
Keene, N.H.
THE AUDIO STORE
Fairfield, Conn.
DeMAMBRO HI-FI
Boston, Mass.
ELECTRONIC WORLD
E. Hartford, Conn.
IMAGES SIGHT & SOUND
LaFAYETTE RADIO
Manchester, N.H.
Concord, N.H.

NANTUCKET SOUND
Hyannis, Mass.
No. Dartmouth, Mass.
OLDE COLONY
Quincy, Cohasset,
Hanover
RADIO SHACK ASSOC.
Marlboro
RESISTOR-TRONICS
Burlington, Mass.
SOUND AUDIO
New London, Conn.
SOUND IDEAS INC.
Avon, Conn., Hartford, Conn.

STEREO LAB
Groton, Conn.
New London, Conn.
SUFFOLK AUDIO
Cambridge, Mass.
SOUND PRODUCTS
No. Smithfield, R.I.
TECH HI-FI
Boston, Cambridge,
Dedham, Framingham,
Stoneham, Waltham,
Worcester, Amherst, No.
Bennington, Vt., Avon,
Conn., Brockton, Mass.,
Northampton,
Portsmouth, N.H.,
Portland, Me.,
Providence, Warwick, R.I.,

Dover, Nashua, N.H.
Burlington, Vt.
Hanover, Mass.
TECH TV & STEREO
Farmington, Conn.,
Simsbury, Conn.
TRIESMAN'S CAT.
SHOWROOM
Manchester, Nashua,
Portsmouth, N.H.
YOU DO IT
ELECTRONICS
Needham, Mass.
WALTHAM CAMERA
Waltham, Mass.

Panasonic CAR STEREO HAS IT

ALL TOGETHER, AND THE STEREO PLACE CAN PROVE IT!!!

Automotive Sound Specialists For All American And Imported Cars, Trucks and Vans

WE HAVE THIS (Limited Quantities Available-First Come, First Served)

PANASONIC CX-232EU* Compact
Stereo Cassette Featuring Fast Forwards; Automatic/Manual Eject; 7 Watts R.M.S.
Size: 4¾"Wx2"Hx6 11/16D; 2.4 Lbs.
$74.95

AND THIS

PANASONIC CR714EU
Compact "In-Dash" AM/FM Push Button Stereo Radio
Features Full Controls,
A.F.C. & Local Distance Switch
Fits Most Compact Cars
(Model For American Full Size Vehicles Slightly More) **$99.95**

ALTOGETHER

PANASONIC CQ-840* "In-Dash"
AM/FM Stereo Radio/Cassette.
Fits almost any vehicle with An Existing Radio Opening.
7 Watts R.M.S.
Size: 7"Wx¾"Hx5¼" D. 3.3 Lbs.
$149.95

*Chromium-Dioxide Tape and C-120 Tape are NOT Recommended for use in ANY Auto Cassette Deck.

PROFESSIONAL INSTALLATION OF SOUND SYSTEMS INTO ANY VEHICLE

Burglar Alarms Installed **$54.95** up With Ace Key — Radio & TV Repair (Mass. Lic. 1005)

master charge THE INTERBANK CARD

THE STEREO PLACE

277 Worcester Rd. — Rte. 9 — Only 25 Minutes From Boston
Framingham (873-9171) Exit 13, Mass. Pike.

(We Accept Mastercharge/Bankamericard/Cash/Travelers Checks. "Sorry, No Personal Checks")

Your BANKAMERICARD welcome here

buy a Scott original

Maybe you hadn't thought of it, but when you buy a Scott audio component, you buy an original, not a copy. Scott originated many of the standard features of today's stereo systems during its past quarter century of innovation in high fidelity. The first stereo amplifier, the first stereo multiplex FM tuner, the first successful solid state receiver, the first FET transistor front end, the first high fidelity components to make use of integrated circuits, the first complementary power output stage, the first four-channel amplifier, the first digital FM tuner and many other developments were introduced by Scott, only to be copied later by others. Many of the brand names widely advertised today weren't even around when Scott introduced the first stereo components commercially in 1958.

When your plans call for the purchase of a high quality receiver, tuner, amplifier or pair of speakers, don't settle for a copy. Buy a Scott original. It costs no more. See your Scott dealer today for a demonstration of the Scott originals. Or circle reader service number for complete product information and list of demonstrating Scott dealers in your area.

H.H. SCOTT
where innovation is a tradition
H.H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. 01754

Dynamic

Continued from page 29

disc. Coupled with this problem is the desire of record companies and record producers to have records cut at as high a level as possible. Their reason for this is to make their records louder than those of their competitors. If all other factors are held constant, a louder record generally sounds brighter (and "better") overall than a quieter one. Radio stations also want the records cut at as high levels as possible so that disc surface noise and pops and clicks will be less audible on the air.

The recorded program is transferred from edited master tape to master disc via a cutting stylus which moves from side to side as it inscribes the program in the walls of the grooves of the master disc. The higher the signal level the farther the stylus moves. If the stylus excursions are too great, adjacent grooves can cut into one another causing distortion and skipping on playback. (See Dave Griesinger's article for an extended discussion of these matters.) To avoid this, the grooves must be spread farther apart when high level signals are cut, and this results in a shorter playing time for records cut at high levels. Even if the grooves do not actually touch each other, very high level signals can cause tracking distortion and skipping due to the inability of the playback stylus to follow very large groove excursions. While high quality arms and cartridges will track large excursions, inexpensive "stereos" will not, and the record manufacturer must cater to the equipment limitations of the mass market.

To produce loud records and avoid the problems of skipping, distortion, and reduced playing times, disc master engineers take advantage of the psychoacoustic phenomenon that the ear's perception of loudness is proportional to the average signal level, not its peak level. By using compression and limiting to increase the average level of the program while restricting the peaks, they produce loud-sounding records without the large groove excursions which would be caused by high peak signal levels.

From the preceding description of signal processing, it can be seen that usually by the time a record reaches the stores, the dynamic range of its program has been squashed.

Restoration

While no recorded performance can fully duplicate all the sensory impressions one receives at the concert hall, club or rock festival, there are several dynamic expanders on the market which can be inserted into the playback equipment chain to restore a substantial portion of the dynamic range which has been sacrificed during the recording process.

The simplest of these is the dbx 117 dynamic range enhancement unit, which permits the listener to expand program material — by up to two times — at the point of playback from discs, tapes or FM broadcasts.

The Phase Linear 4000 preamplifier incorporates a dynamic expansion section which unlimits previously limited material, and expands downward from a threshhold to "open up" the music to a more nearly lifelike dimension.

And, finally, the RG (for Robert Grodinsky, its inventor) expander has been shown to audio editors and is being evaluated by Pioneer, reportedly for possible inclusion in their line in the future.

Power

Continued from page 32

nately, transistor failures are much rarer than tube failures, but still we need protection.

The bad news is that protective devices in transistor amplifiers can cause distortion, especially in musical transients. Such distortion does not show up in lab test reports, but it is real and it tends to be a more common fault in higher-powered amplifiers than in low-to-medium-powered ones.

Protection takes two forms: 1) passive devices, such as fuses and circuit breakers, and 2) active electronic circuits. Fuses and circuit breakers are placed in the speaker lines, in the output stage circuitry, or in the power supply. They are inexpensive, can be arranged to have no effect on the sound, and will blow to prevent excessive sustained current from flowing through the output transistors or through the speaker. However, there are certain circumstances in which output transistors can be destroyed faster than the fuses can act, so fuses and circuit breakers provide only 99 percent protection. Active electronic protection circuits can provide 100 percent protection, but at a price: they cost more, and (more important) they can introduce distortion.

Electronic protection circuits work by sensing the current in the output stage, acting to limit the output of either the driver stage or the power supply when the current exceeds a specified value, and then restoring normal operation when the current demand goes back below that value. A fuse takes many thousandths of a second to blow and so will not act on very brief overloads. But active protection circuits can act so fast that they can instantly shut down an amplifier for a thousandth of a second, then turn it on again for a couple of thousandths, then off again for a thousandth. Thus they can alter part of a musical waveform while leaving the rest of the waveform alone, and since the amplifier continues playing you would have no way of knowing that anything is wrong except that the altered waveform causes loud parts of the music to have an irritating, harsh, or buzzy quality.

So a potential conflict can arise between sound quality and reliability in amplifiers. An amplifier with passive protective devices can, if well designed, be driven up to a loudness level at which momentary musical peaks are actually exceeding the amplifier's rated output power — and still sound good. But there is a slight chance that someday an unusual overload condition will arise which will blow out the output stage before the fuses can act. In order to provide total protection, many amplifiers contain active circuits that react to those portions of musical peaks which would draw enough current to threaten a transistor if they persisted. So the protection circuit reduces the amplifier's peak power capability and may introduce some audible distortion at average power levels below the rated power.

The tricky problem for the designer is that in amplifiers of under about 100 watts per channel, what destroys transistors is not simply current but heat. An amount of current that would heat a transistor to destruction in 10 milliseconds might be quite safe for five, but the protection circuit doesn't know that, so it overreacts. A fuse might not pop until 20 millise-conds, leaving a potential danger zone for careless users of the amplifier. Most manufacturers, knowing that a reputation for unreliability is deadly for sales, opt for the active protection and assume that most buyers won't be bothered by the sacrifice in sound quality at high loudness levels.

A few manufacturers have tried another approach. They use fuses in order to eliminate the potential distortion of active protection circuits. To insure against transistors' blowing out faster than the protective fuses, they use more rugged transistors than the amplifier's continuous-power rating would normally require, or they use multiple transistors in parallel to increase the safe current-carrying capability. For example, to deliver 60 watts to a 4-ohm speaker, the output transistors must provide a current of 4 amperes at 15 volts. Using output transistors rated to handle 4 amperes, a designer could use a protection circuit to ensure that no more than 4 amperes would ever pass through the transistor. Or, to avoid the distortion that this might cause, the alternative approach is to omit the active circuit and use more costly six-ampere transistors or pairs of three-ampere devices; the output stage could then handle momentary peaks of 144 watts (six amperes at 24 volts) without distortion or breakdown.

This conservative approach works fine in amplifiers rated under 100 watts or so, where current-heating is the sole destroyer of transistors. But as the power goes up, both the currents and the voltages rise. Under 100 watts, voltages of 10 to 30v are typical and are easy to work with. But a 500-watt amplifier may have to handle peak voltages of 50 to 100v, and the power supply voltages have to be correspondingly high to avoid clipping. In this situation output transistors are vulnerable to another mode of destruction: "secondary breakdown," essentially a short-circuit due to the high voltages within the transistor. Until someone invents a high-power transistor immune to secondary breakdown, the conservative approach to amplifier design (using only passive protection devices) will not be practical. Active protection circuits must be used, and are used, in all very-high-power amplifiers.

So consumers considering the purchase of an amplifier or receiver face an evaluation problem which has been generally ignored in published test reports: what is the effect of the protection circuitry on the sound, particularly on musical peaks which drive the amplifier to beyond its rated continuous power? This question arises when superpowered amplifiers are compared against each other, since various designers employ different protection circuits. It also arises in the comparison of a super-powered amplifier against one in the 50-100 watt range, since some medium-power amps can comfortably be driven well above their rated power on momentary peaks while some super-power amps barely make it to their rated power before audibly breaking up. Finally, the question also arises when comparing low-to-medium power amplifiers and receivers, since some use active circuits and others use passive devices.

Evaluation of the effects of protection circuits is further complicated by the fact that the overload behavior of an amplifier depends on the speaker it is driving. This is because speakers are "reactive." When the amplifier, playing music, sends a pulse of current to the speaker, the changing current creates a moving magnetic field around each speaker's voice coil and around any crossover inductors. The magnetic field then induces a reverse current in the speaker circuit that goes back to the amplifier. The reactive current passes through the output transistors and is then grounded or absorbed by the power supply. (The more efficiently the amplifier absorbs reactive current, the higher its "damping factor.") Now the problem is that the protection circuits, sensing output stage current, may interpret reactive current as a dangerous power overload and cause the amplifier to distort even when the actual sustained power level is not high. Depending on the design of the circuit, an amplifier may respond to reactive current by becoming unstable and producing prolonged distortion and noise, muddying the sound of music.

This kind of problem does not show up in equipment test reports because amplifiers are tested (and designed) while feeding their power to resistors, not speakers. And the severity of the problem will depend on the kind and degree of the speaker's reactance. So while two amplifiers may sound equally good with speaker A, one may perform much better than the other with speaker B.

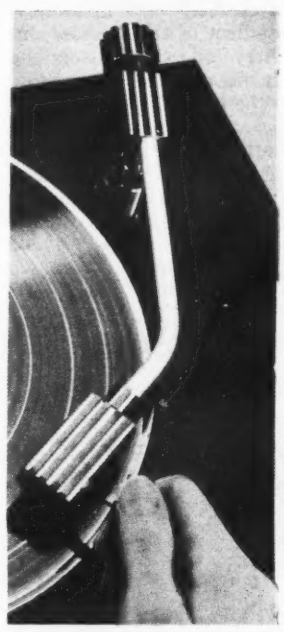
We began this article with the question, "How much power do you need?" and we suggested that it is an unanswerable question. It should be clear by now that even if a numerical power figure could be specified, it would not guide your choice of amplifier because there is no simple correlation between an amplifier's specified or tested power rating and its actual ability to drive your speakers with undistorted musical power. There is no substitute for actually listening to the amplifier/speaker combinations that interest you, using wide-range musical material, in an acoustical environment similar to your own listening room.

Actual, unretouched photo of an oscillograph test.
The sound of a fingerprint
The oscillograph you see is an actual photo of a high-quality audio system "playing" a fingerprint.
You're hearing some now through your speaker system. Instead of the sound your precious discs are capable of. And no vacuum record cleaner, brush-arm or treated cloth will remove them. None.
But Discwasher™ with new dm fluid— removes fingerprints completely. Along with dust. And manufacturing lubricants (added to make pressing faster) that can act like grove-blocking fingerprints. All this cleaning without pulling polymer stabilizers from your vinyl discs.
Discwasher™. The only safe, effective way to silence the printed finger. At Audio specialists world wide.
Discwasher, Inc.
909 University, Columbia, Mo. 65201
dm

Before you buy a manual turntable, consider what "manual" really means.

"Manual" means more than just "single play." Every time you play a record, you must pick up the tonearm and move it to the record. And at the end of play, you must stop whatever you're doing, go to the turntable and return the tonearm to its resting post. All by hand.

If your hand is steady enough to handle the virtually weightless end of the tonearm, and if you enjoy getting involved with every record, a manual turntable may suit you nicely.



But if you don't want to risk your delicate stylus and your fragile records, you'll be happier with the convenience and security of an automatic turntable. Especially a Dual.

Many music lovers and audio experts who formerly owned manual turntables are now Dual owners. They include hi-fi editors, record reviewers and the readers of the leading music/equipment magazines. And they own more Duals than any other make of quality turntable.

All these experts did not switch to Dual for convenience alone. They knew that by choosing a Dual, any Dual, they could enhance their enjoyment of records, as easily as you can.

Automatically.

Dual

The multi-play automatic Dual 1229Q, $259.95.
Other multi-play automatics from $129.95. All less base and dust cover.
Single-play automatics are the Dual 601, $270;
and the electronic direct-drive Dual 701, $400.
Both include base and dust cover.

See Dual at any of these leading high fidelity dealers.

MASSACHUSETTS

Boston
Atlantis Sound
Copley Camera
Olson Electronics
DeMambro Electronics
Lafayette Radio
Tech Hi Fi
Stereo Sound
Billerica
Lafayette Radio
Braintree
Atlantis Sound
Brockton
Tweeter, Etc.
Brookline
Tweeter Etc.

Burlington
Lafayette Radio
Stereo Sound
Cambridge
Atlantis Sound
Olson Electronics
Lechmere Sales

Hanover
Olson Electronics
Minute Man Radio
Tech Hi Fi
Stereo Sound
Tweeter, Etc.
Wolf & Smith
Chestnut Hill
Tweeter, Etc.
Cohasset
Olde Colony Stereo
Danvers
Con-Sonics
Lechmere Sales
Dedham
Lechmere Sales
Tech Hi Fi
Tape Place
Falmouth
Ortin's Photo
Fitchburg
Fitchburg Music
Framingham
Atlantis Sound
Tech Hi Fi
Olde Colony Stereo

Hyannis
Draper International
Nantucket Sound
Lawrence
Malco Electronics
Malden
Sound Enterprises
Medford
A & W Electronics
Natick
Lafayette Radio
Needham
You-Do-It
Peabody
Atlantis Sound
Olson Electronics
Quincy
Olde Colony Stereo
Saugus
Lafayette Radio
Stoneham
Tech Hi Fi

Waltham
Tech Hi Fi
Waltham Camera
Watertown
Arkay Electronics
Wellesley
Olson Electronics
Music Box
W. Bridgewater
Tape Place Two
W. Roxbury
Lafayette Radio
Worcester
Leib Electronics
Hi Fi House
Tech Hi Fi

NEW HAMPSHIRE

Dover
Tech Hi Fi
Hanover
Tech Hi Fi
Keene
Melody Shop
Manchester
Bi-Rite Mdsers.
Treisman's
Nashua
Tech Hi Fi

RHODE ISLAND

Coventry
Stereo World
No. Kingston
Stereo World
Pawtucket
Apex, Inc.
Providence
Atlantis Sound
Lafayette Radio
Tech Hi Fi
Stereo Places
Warwick
Joe's Stereo Center
Tech Hi Fi
Woonsocket
Sound Track
Ed's TV